JPRS 77813

13 April 1981

China Report

SCIENCE AND TECHNOLOGY

No. 94

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 77813

13 April 1981

CHINA REPORT

SCIENCE AND TECHNOLOGY

No. 94

CONTENTS

PEOPLE'S REPUBLIC OF CHINA

APPLIED SCIENCES

Characteristics of U.S., Soviet Spy Satellites Described
(Li Pengfei, Tong Yin; DIANZI SHIJIE, No 11, 1980) 1

Hollow Projectile Properties, Potentials Researched
(Li Huichang, et al.; BINGGONG XUEBAO, Jun 80) 8

Finite Element Analysis of Projectile Elastoplasticity
(Wei Huizhi, et al.; BINGGONG XUEBAO, Dec 80) 23

LIFE SCIENCES

New Cancer Injection Drug Found Successful
(JIEFANG RIBAO, 3 Dec 80) 34

Briefs
- Drug Price Readjustment 35
- Semisynthesized Drug for Leukemia 35

PUBLICATIONS

Table of Contents of 'HUAZHONG GONGXUEYUAN XUEBAO' No 3, 1980 37

Table of Contents of 'DIANLI XITONG ZIDONGHUA' No 6, 1980 40

Table of Contents of 'DIANLI JISHU' No 12, 1980 and No 2, 1981 42

Table of Contents of 'HE JISHU' No 1, 1981 47

ABSTRACTS

CEMENT

SHUINI [CEMENT] No 1, 2, 1981 49

COAL SCIENCE

MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] No 1, 1981 52

OCEANOLOGY

HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA, No 1, 1981.... 55

OIL GEOPHYSICAL PROSPECTING

SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] No 1, 1981... 58

PRINTING TECHNOLOGY

YINSHUA JISHU [PRINTING TECHNOLOGY] No 2, 1980 63

SOLAR ENERGY

TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] No 2, 1980 and No 1, 1981 65

APPLIED SCIENCES

CHARACTERISTICS OF U.S., SOVIET SPY SATELLITES DESCRIBED

Beijing DIANZI SHIJIE [ELECTRONIC WORLD] in Chinese No 11, 1980 pp 2,3, 30

[Article by Li Pengfei [2621 7720 7378] and Tong Yin [2717 7299]: "Electronic Reconnaissance Satellites--A New Chapter in Espionage"]

[Text] A Rising Star in Espionage

Space reconnaissance satellites have been praised by some people as the new scout in space but put down by others as spies in the sky. Opinions can vary widely. Nonetheless, whether they are viewed as scouts or spies, the technological advances of the past 20 years are so outstanding that they can justly be called the rising stars.

Espionage is a mysterious profession and has been the subject of many writers and the theme of many movies. The film "Silent Man" focuses on the cruelty of the spy war. In the reality of today's society, however, the obscure intelligence activities are increasingly difficult due to stepped-up counterintelligence measures. It has been said that all the intelligence collected by the United States through its spy channels amounts to a mere 1 percent of its total intelligence. Besides, the credibility of the information collected is often doubtful because the counterespionage war of today has become so complex, intense and tricky.

The intelligence collected by one surveillance satellite in 1 day is more than a spy organization can gather in several years. At the U.S. National Security Agency, there are usually tons of information collected by information-gathering stations in the sky and on the ground that are waiting to be processed. And these intelligence sources are often completely reliable. This goes to show the enormous capability of the spy satellites in space. They are indeed writing a new chapter in spy history with these unique features:

--"Legitimate" Spy

One often hears that some diplomat has been declared persona non grata by a certain country and given a deadline to depart. This type of infamous incident is often related to spy activities. In 1960, an American U-2 airplane was shot down over the Russian industrial city of Sverdlovsk and became a typical example of a spy plane causing a great deal of political trouble. Reconnaissance satellites are different from spy planes. Ever since it was formally recognized in the Soviet-U.S. SALT I agreement that a country can carry out verification using technical means without interference, satellite spy activities have gained the status of "international legitimacy." The fact is that a satellite in quasicircular orbit at an altitude of 300-500 kilometers and capable of in-orbit dynamic maneuver is very difficult to intercept with current antisatellite technology. Thus, they are not only legitimate, but also safe and reliable spies.

--Fast Surveillance

Using electronic reconnaissance satellites that revolve around the earth once every 90 minutes, the entire globe can be surveyed in about a week.

--Tireless Scout

A spy satellite flies around the earth 10 to 20 times every day and can be used in carrying out long-term continuous surveillance of important military targets. But when there is a spear, there is a shield; countersurveillance also comes with surveillance. Based on the orbit parameters of a satellite, it is not difficult to judge whether a satellite is a spy satellite and to compute its schedule for flying over various regions. Thus, a satellite's reconnaissance effectiveness can be reduced by maintaining radar and radio communication silence or by producing fake signals when the satellite is flying overhead so that it receives no signal or is cheated. To counter these measures, multiple satellites in different orbits can be used so that a location is constantly surveyed by satellites and the countersurveillance is partially neutralized. Along with technological breakthroughs, launching surveillance satellites into synchronous orbit is being considered. Countersurveillance measures in the future will be even more difficult.

Surveillance satellites can be divided into photographic surveillance, electronic surveillance, ocean monitor and early-warning satellite. They share certain similarities. We shall now describe the mission and history of electronic space surveillance satellites.

Armed With Electronics

Among the spy satellites, those equipped with electronic equipment have higher seniority and carry heavier responsibilities:

1. They are used in the accurate determination of the location of antiaircraft and antiballistic missile radars and in assessing their signal characteristics and action distance. Signal characteristics include the working frequency, the pulse width and repetition rate, the rotational speed and beamwidth of the antenna. With this information in hand, strategic bombers and other strategic weapons, equipped with the proper electronic counterequipment, can then choose the most favorable route and penetrate the enemy air defense.

2. They are used in locating military radio stations, in eavesdropping and recording intelligence communications between military units and between government and military departments. When this information is combined with the analysis of other intelligence collected on the testing, production and stationing of military hardware, one would know the long term plans and short term intentions of other governments and their armed forces.

To accomplish these missions, the satellite-borne electronic system consists mainly of a receiver, a terminal device, and a high-speed transmitter. The operating procedure in essence is as follows: The receiver intercepts the signal and carries out preliminary analysis to determine the location and signal characteristics. The processed signals are then fed into the terminal device. Due to the stringent weight limitations on satellite-borne equipment, terminals on early models of Soviet and American electronic spy satellites consisted of only a magnetic tape recorder. The signals intercepted were stored in the recorder in their entirety without further processing. When the satellite flew over the ground station, the signals were transmitted to the ground by high-speed transmitter for detailed processing and analysis. This scheme requires a large capacity recorder and a high-speed transmitter so that a large number of signals can be transmitted to the ground station in just a few minutes. It is difficult for this method to accomplish the assigned mission when the signal density is too high.

With the development of microprocessor applications, satellite terminals are becoming more complex and are now capable of preprocessing all or part of the signals detected. The preprocessing may include signal measurement, correlation process, data reduction, rearrangement and comparison with previous data. Only the processed data are sent to the ground station. This has greatly helped the single-satellite electronic surveillance method in solving its problems of insufficient storage capacity and transmission speed.

In the multiple-satellite electronic surveillance system, since a network of satellites and a number of properly placed ground stations are used, there is no need for satellite-borne terminals, and all the signals detected by the multichannel receivers on the satellites can be rebroadcast in real time. In this system there are three models of operations: (1) receiving (storage) and rapid transmission; (2) receiving, processing and transmitting; and (3) simultaneous receiving and transmitting, as shown in Figure 1.

The performance of a satellite detection system is determined mainly by the receiver. Although there are similarities between a satellite-borne radar receiver and those on the ground, on ships and in aircraft, the satellite receiver encounters situations that are much more complex and the requirements are correspondingly higher. The requirements are:

1. Rapid interception of high-density signals.

For an orbit altitude of 400 km, the instantaneous field of view of a satellite is 15 million square kilometers. Assuming there is one radar working in every 10,000 square kilometers, then the satellite receiver will have 1,500 signals to locate, intercept, sort out and process.

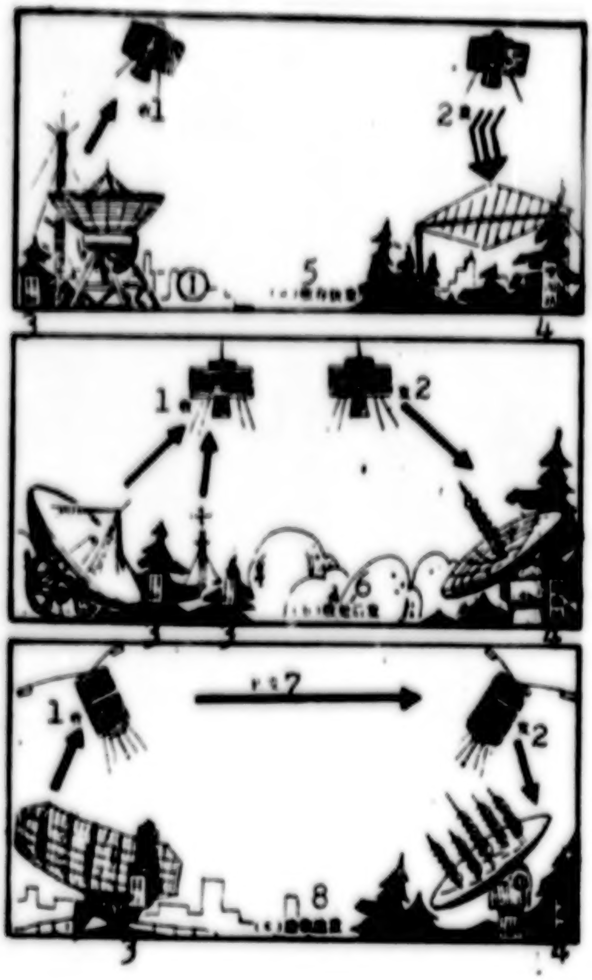


Figure 1

Key:

1. Receiving
2. Transmitting
3. Target
4. Ground station
5. Receiving, storage and rapid transmission
6. Receiving, processing and transmitting
7. Rebroadcasting
8. Simultaneous receiving and transmitting

2. High sensitivity for side lobe detection.

Ordinary receivers can detect the main lobe radiation of a radar. However, since the radar usually operates at a rather small angle of inclination and its narrow main lobe is not pointed toward the satellite, the satellite receiver has only very limited time to detect such signals and, as a result, the accuracy for localization is low and the probability for missing the signal is high. It is therefore generally necessary to detect the side lobe radiation with long distance receivers, and high sensitivities (on the order of 110 dBw) are required to do this.

3. Reception to many different signals.

Satellite receivers detect radar signals from all over the world and encounter signals at different frequencies from different radar systems. They are especially required to handle signals from new types of radars such as frequency segregation, pulse compression and rapid-change frequency radars.

4. High degree of accuracy in frequency and location determination.

To satisfy the requirements of intelligence assessment, the error margin in frequency measurement is about 0.2-2.5 percent and the location accuracy should be within 50 km.

The crystal video frequency receivers (direct detection and direct sending) used in traditional radar reception have low sensitivity and are not suitable for satellite use. Superheterodyne searching receivers are more sensitive and more accurate in frequency determination, but their interception probability and ability to adapt are too low. Instantaneous-frequency receivers have a higher probability for intercepting signals and are capable of detecting radar signals with rapidly changing frequency, but they too have the disadvantage of low sensitivity. A composite receiver incorporating the superheterodyne and the instantaneous-frequency features will greatly improve the performance.

Among the new receiving systems, the multichannel signal receiver has gained some maturity. In this system the signals are processed in many channels according to their frequency. The advantages of this type of receiver are that they are highly adaptive, they have high interception probability and they are accurate in frequency measurement and in localization. Despite their disadvantages of bulkiness and complexity, they are still considered the receivers of high performance.

Soviet and American Satellites

The most intense struggle in the spy war is between the Soviet Union and the United States. The spy satellites launched by these two countries in each year are listed in the table below: [table on following page]

The Soviet Union began launching spy satellites in 1967, and as of December 1979 had launched a total of 144 satellites. Soviet satellites can be divided into three types: Type I is a 400 kg satellite, ellipsoidal in shape, and, according to its mission, flies in 3 different orbits (perigee at 270 km and apogee at 400, 800, and 1,500 km, inclination angle at 71 degrees and 82 degrees). The working life of Soviet Type I satellite varies with orbit and launch date but is in the range of 50-700 days. Some of these satellites also carry out military weather surveillance missions. The Type II Soviet satellite is 900 kg, cylindrical, with a quasicircular orbit of 530 km altitude and 74 degrees inclination. Several Type II satellites usually form a network to perform their principal duty of eavesdropping on military communications, and their working life is more than 1 year. The third type of Soviet satellite is a giant 2,500 kg

Table: Electronic Spy Satellites Launched by the Soviet Union and the United States in the Last 18 Years*

	Soviet Union				United States		
Year	Type I 400 kg	Type II 900 kg	Type III 2500 kg	Total	Reconnaissance satellite	Detailed surveillance satellite	Total
1962					-	3	3
1963					3	2	5
1964					2	3	5
1965					3	1	4
1966					3	2	5
1967	6	1	-	7	3	1	4
1968	7	2	-	9	5	2	7
1969	10	2	-	12	4	1	5
1970	11	3	1	15	3	1	4
1971	11	6	1	18	1	1	2
1972	9	3	2	14	3	-	3
1973	9	4	1	14	1	-	1
1974	6	4	1	11	2	-	2
1975	5	3	2	10	-	-	-
1976	4	5	2	11	1	-	1
1977	2	6	3	11	-	-	1 [sic]
1978	-	2	4	6	1	-	1
1979	-	-	6	6			
Totals	80	41	23	144	35	17	52

*Based on satellite orbit analysis, estimates may not be totally accurate.

cylindrical satellite with a 630-km quasicircular orbit. The principal use of this Type III satellite before 1970 was for military weather surveillance, and since then it has been used in electronic reconnaissance as well. Type III has fairly good characteristics: it can measure frequency over a wide band, record more information and carry out preliminary analysis of the signals detected. It is believed that the Type III satellite has now replaced the Type I satellite.

None of the Soviet electronic spy satellites uses real time data transmission. Signals are transmitted rapidly to specific ground stations as the satellite flies over the Soviet Union. The peak launching period of Russian satellites was from 1970 to 1973, and the frequency decreased after that. One could assume that the Soviet Union has completed its preliminary mapping of the radar stations around the world, and newly launched satellites only serve the listening function.

The United States started launching electronic spy satellites earlier than the Soviet Union, but has launched a much smaller number of satellites. From 1962 to 1978, a total of 52 satellites were launched; among them 35 were reconnaissance satellites and 17 were detailed-surveillance satellites. The general-surveillance satellite is smaller in size and lighter, carrying relatively simple electronic instruments. For example, the typical general-surveillance satellite P-11 is octagonal, with dimensions of 89x89x39 cm and weighs 59-157.5 kg. It is usually put into orbit piggyback on a large photoreconnaissance satellite. There has been a marked reduction in the number launched in recent years, generally 1-2 per year. The orbit of this type of satellite is not concentrated over a specific region--its mission is to perform broad surveillance and look for new targets.

The detailed surveillance satellite is much larger. It is a spherical cylinder 8 meters long and 1.52 metres in diameter, with a mass of 1,500-2,000 kg. It carries more complex and sophisticated electronics and can perform precision localization and analysis. However, its launching has been discontinued since 1972. It is believed that its mission has been transferred to the photoreconnaissance satellite called the "Big Bird."

The peak launching period of American electronic spy satellites was in the late 1960's. One can assume that in a few years time they also mapped out the radar distribution of the world. It has been reported that the third-generation electronic spy satellite of the United States is equipped with computers which carry a list of the signal characteristics of radars around the world in its memory. As it roams the sky, it is only necessary for it to perform a continuous signal comparison. Only when signals not in the memory that come from a radar of a new type or new location are detected will the satellite automatically perform signal analysis and carry out direction and location determination with its electronic devices.

It can be anticipated that the electronic surveillance satellites, the spies in the sky, will also enter the era of computer-controlled automatic data processing.

9698
CSO: 4008

APPLIED SCIENCES

HOLLOW PROJECTILE PROPERTIES, POTENTIALS RESEARCHED

Beijing BINGGONG XUEBAO /ARMENTARII/ in Chinese No 2, Jun 80 pp 32-41

[Article by Li Huichang [2621 1920 2490], Yang Jinyao [2799 6855 5069] and Qi Rongchang [4359 2837 7022]: "Hollow Projectile Study"]

[Text] Abstract

(Received 15 November 1979)

Hollow projectile, also known as a tube projectile, is basically a thin-walled tube. It is characterized by its light-weight, high muzzle velocity and desirable aerodynamic properties. Hence it provides the advantages of lower impulse, straighter trajectory, smaller dispersion and excellent penetrating power.

Based on the previous work of other authors and our recent experimental results, this paper deals with the hollow projectile in more detail. Here, its drag characteristics, accuracy of dispersion and penetrating power are fully described; its gyroscopic stability is compared theoretically with that of a solid projectile; an approximation method for estimating its drag characteristics is developed and, in the conclusion, the authors present their opinions and recommendations concerning the potential military applications of this type of projectile.

I. Analysis of Drag Characteristics

As is well known, a projectile flying in the exterior trajectory is under the influence of air resistance. The resistance on a regular supersonic projectile consists of three major parts: the wave drag, the base drag, and the frictional drag. The first 2 parts amount to more than 80 percent of the total resistance. Theoretically, hollow projectiles can eliminate (or greatly reduce) the wave drag and the base drag. Since they encounter very little resistance in their flight, their aerodynamic characteristics can be substantially improved.

Since the principles of drag reduction in hollow projectiles have been described in detail in the literature (see Ref 1), we will not repeat them here. Instead we only show the flight characteristics of an inner-cone type hollow projectile (see Figure 1) for the convenience of discussions to follow. If the hollow projectile is to have good characteristics in the exterior trajectory, it must fly in its high performance region. That is, the ratio of the throat area to the

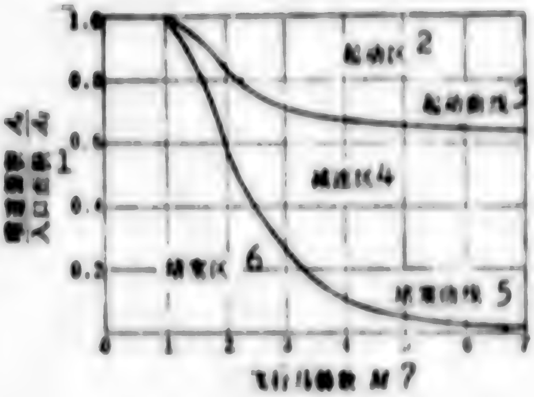


Figure 1. Flight Characteristics of an Inner-Cone Type Hollow Projectile

Key:

1. (Throat area)/(inlet area)
2. Startup region
3. Startup curve
4. Deceleration region
5. Blockage curve
6. Blockage region
7. Flight Mach number, M

inlet area, A_t/A_i, at the startup and the flight Mach number M must fall in the startup region in Figure 1 and, after the startup, A_t/A_i and M should fall in the startup region and the deceleration region.

Experimental investigation of the drag characteristics of hollow projectiles can be carried out in two ways: wind tunnel model test and target range live firing test. Experiments yield the following results:

(1) Wind tunnel experiments have confirmed the fact that inner-cone type hollow projectiles do have "startup" problems. Theoretical values of the minimum startup area-ratio (obtained from Figure 1) and experimental results are listed in Table 1. As can be seen, the experiment and the theory are in agreement.

Table I.

M \ A_t/A_i	Theoretical values	Experimental values
2.0	0.822	0.801~0.826
2.5	0.760	0.760~0.785
4.0	0.662	0.650~0.677

The drag on the wind tunnel model during "startup," as measured by a stress balance, shows pronounced jump phenomenon. At M = 2.0 and M = 2.5, the drag after the jump is three times the drag before the jump. For M = 4.0, it is five times. An observation of the ripple pattern reveals that the wake is different before and after the jump, see Figure 2. Before the jump the wake is a supersonic flow and it becomes subsonic after the jump. However, no detached bow shock at the inlet of the projectile is observed. Based on an analysis of the observations, the jump is probably caused by the complex wave systems inside the tube (such as the λ-wave). Admittedly, the actual situation of the flows inside the tube is not yet known and further investigations are called for. In addition, the drag of the outer-cone type projectile model shows no jump and the absence of the "startup" and the "blockage" problems in the outer-cone hollow projectile has been confirmed.

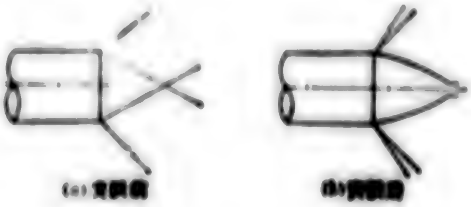


Figure 2. Schematic Diagram of the Wake of the Hollow Projectile

Key: (a) Before jump (b) After jump

(2) Types of projectile body structures. Among the many types of body structures of the hollow projectile, there are the inner-cone type, the outer-cone type, and the hybride type, as shown in Figure 3. Theoretically the inner-cone type hollow projectile can completely eliminate the wave drag and the base drag and encounters the minimum air resistance. The outer-cone type of body still has some wave drag and base drag, but, due to its very small nose cone angle and base area, these drags are very small and the flight resistance is far less than the regular projectile. Wind tunnel experiments have shown that the drags on the inner-cone and outer-cone hollow projectiles do not differ very much (with the inner-cone in its startup condition) for the same nose cone angle and area-ratio A_t/A_i. Based on the technical, usage and service requirements, we have chosen the outer-cone structure for firing tests. In addition to the low drag property, the outer-cone structure has another outstanding advantage--at $A_t/A_i = 1$, it does not suffer from startup and blockage problems, as a result, its low drag behavior is not limited to any flight speed and the projectile can be used at high speed as well as at low speed.

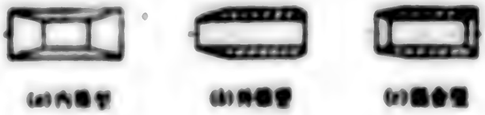


Figure 3. Types of Projectile Body Structure

Key: (a) Inner-cone (b) Outer-cone (c) Hybride

(3) In comparison to regular projectiles, the air resistances on hollow projectiles are greatly reduced.

In wind tunnel experiments, the drag coefficient of hollow projectiles at $M = 2.0\sim4.0$ is measured to be in the $0.05\sim0.12$ range, approximately $1/5\sim1/3$ of the regular projectile value. The values obtained from live firing tests are somewhat higher, approximately $0.10\sim0.15$, or, about 1/3 the value for regular projectile. Analysis shows that this difference with the two methods originates from (a) wind tunnel experiments are carried out under the condition of zero attack angle while in live firing there exists a certain amount of nutation, and (b) real bullets are rather small in size and product quality is hard to control. Especially the thickness of the leading edge, the surface smoothness, and the squeeze-in deformation in the bore all have relatively large effects. Evidently, with sound structural design and improved manufacture quality, it is possible to reduce the drag coefficient of the hollow projectile to 1/3 the regular projectile value.

(4) Drag coefficient C_D increases with decreasing area-ratio A_t/A_m and with increasing cone angle ε. Wind tunnel test results at $M = 4.0$ are shown in Table II.

Table II.

A_t/A_m	0.67	0.60	0.55	0.50	0.45	0.40	0.255
ε (°)	7	9	10	11.5	13	14.5	6
C_D	0.0447	0.0576	0.0667	0.0771	0.0926	0.1039	0.1435

(5) The sharpness or bluntness of the projectile's leading edge has extremely large effects on the total drag.

Table III shows the firing results of 12.7mm hollow bullets. Results of wind tunnel experiments indicate that the additional wave drag coefficient C'_{DW} caused by the thickness of the leading edge is directly proportional to the relative thickness of the leading, $t/\frac{d}{2}$ (i.e., leading edge thickness/projectile radius).

Table III.

Type of Projectile	Leading edge thickness t, in mm	Drag coefficient C_D
Design I (sharp edge)	0[1]	0.1109
Design I (blunt edge)	0.30	0.2570

---

[1] In practice it is not possible to have $t = 0$, the graph requires it to be smaller than 0.10mm.

(6) The thickness of the sabot (or, the projectile base) also affects the drag characteristics.

Results of wind tunnel experiments indicate that the base drag coefficient C_{Db} of a hollow projectile is directly proportional to the relative thickness of the base, A_b/A_m (i.e. projectile base ring area/maximum cross sectional area).

II. Approximation Method for Drag Characteristics

According to Ref (1), the formula for computing the drag coefficient for regular cone-cylinder projectiles is given by:

$$C_D = \left[2\sin^2\varepsilon + \frac{0.5\sin\varepsilon}{\sqrt{M^2-1}}\right] \qquad \text{波阻 wave drag}$$

$$+\left[\frac{K}{\frac{1}{2}\gamma M^2}\right] \qquad \text{底阻 base drag} \tag{1}$$

$$+\left[\frac{4l}{d}\left(\frac{0.074}{Re^{0.2}} - \frac{1700}{Re}\right)\Big/\left(1 + r\frac{\gamma-1}{2}M^2\right)^{0.4}\right] \qquad \text{摩阻 friction drag}$$

where M = Mach number
R_e = Reynolds number using projectile length as the characteristic length
ℓ = projectile length
d = diameter
ε = half apex angle of the nose cone
γ = specific heat ratio (take $\gamma = 1.4$ for air)
r = restitution coefficient (generally $r = 0.85$)
K = correction factor for the base drag

According to our study, the drag characteristics of hollow projectiles can be estimated using the following method:

1. Outer-cone type hollow projectile

For outer-cone hollow projectiles with a sharp leading edge, the wave drag at the nose can still be calculated using the first part of Equation (1) except now the frontal area is the projection area A of the nose cone on the cross section of the projectile.

When the leading edge has a certain thickness, then the additional wave drag, C'_{DW}, needs to be considered as well. As discussed before, $C'_{DW} \propto t/\frac{d}{2}$. Moreover, one can expect that C'_{DW} also depends on the circumference of the leading edge. Evidently, for the same M and t, C'_{DW} is greater for a greater circumference at the leading edge. In preliminary calculations, C'_{DW} can be regarded as directly proportional to the relative circumference (i.e. leading edge circumference/ circumference of the largest cross section of the projectile), that is,

$$C'_{DW} = \left(\frac{\pi d'}{\pi d} - \frac{d'}{d}\right) \tag{2}$$

hence $$C'_{DW} = k_1 \frac{td'}{d}$$

where d' and d are respectively the inner and outer diameters of the projectile; t is the thickness of the leading edge and k_1 is a proportionality constant that depends on the value of M. The values of k_1 obtained from wind tunnel experiments are given in Table IV.

Table IV.

M	2.0	2.5	4.0
k_1	4.96	5.50	6.85

In the presence of a constricted tail, the wave drag of the tail should also be computed. The windward area of the constricted tail is its projectional area $(A-A_b)$ on the cross section of the projectile. Thus, one can write the wave drag equation of the hollow projectile as:

$$C_{DW} = \left(2.1\sin^2\varepsilon + \frac{0.5\sin\varepsilon}{\sqrt{M^2-1}}\right)\frac{A}{A_m} + \left(2.1\sin^2\varepsilon' + \frac{0.5\sin\varepsilon'}{\sqrt{M^2-1}}\right)\frac{A-A_b}{A_m} + k_1\frac{td'}{d^2} \quad (3)$$

where ε' is the constriction angle of the tail, as shown in Figure 4.

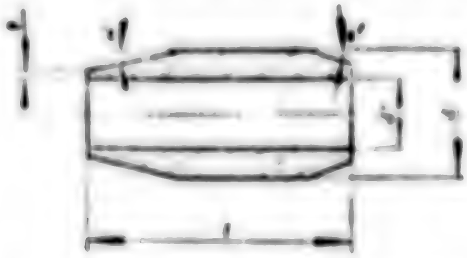


Figure 4. Outer-Cone Type Projectile Body

Because of the existence of internal flows, the base drag of the hollow projectile is much smaller than that of solid projectiles. Hence, the second term in Equation (1) is no longer valid. As mentioned before, the base drag coefficient of the hollow projectile is proportional to the relative area of the base, or,

$$C_{Db} = k_2 \frac{A_b}{A_m} \tag{4}$$

in which k_2 is a proportionality constant dependent on the value of M. Values of k_2 as obtained from wind tunnel experiments are given in Table V.

Table V.

M	2.0	2.5	4.0
k_2	0.102	0.154	0.214

The frictional drag of a hollow projectile can also be computed according to the third term in Equation (1). Since we now have both the inner frictional surface and the outer frictional surface, we include a factor of 2 in the approximation:

$$C_{Df} = \frac{8l}{d}\left(\frac{0.074}{Re^{0.2}} - \frac{1700}{Re}\right)\Big/\left(1 + r\,\frac{\gamma - 1}{2}M^2\right)^{0.5} \qquad (5)$$

In the calculation of hollow projectile drag characteristics using Equations (3)-(5), a number of secondary factors are neglected, such as the nutation in the flight. In the approximate calculation, one can use an approximate magnification factor (say, 1.10) to take these secondary factors into account collectively. We then obtain the following formalism for the drag coefficient of the hollow projectile:

$$C_D = 1.10\left\{\left(2.1\sin^2\varepsilon + \frac{0.5\sin\varepsilon}{\sqrt{M^2-1}}\right)\frac{A}{A_m} + \left(2.1\sin^2\varepsilon' + \frac{0.5\sin\varepsilon'}{\sqrt{M^2-1}}\right)\frac{A - A_b}{A_m}\right.$$
$$\left. + k_1\frac{td'}{d^2} + k_2\frac{A_b}{A_m} + \frac{8l}{d}\left(\frac{0.074}{Re^{0.2}} - \frac{1700}{Re}\right)\Big/\left(1 + r\,\frac{\gamma - 1}{2}M^2\right)^{0.5}\right\} \qquad (6)$$

in which M = Mach number

Re = Reynolds number, using the projectile length as the characteristic length

A = area of the cross sectional ring of the projectile

A_b = area of the base ring

A_m = maximum cross sectional area (reference area)

d = projectile diameter

d' = inner diameter

ℓ = projectile length

t = thickness of the nose cone leading edge

ε = half apex angle of the nose cone

ε' = constriction angle of the tail

r = restitution coefficient

γ = specific heat ratio

k_1, k_2 = proportionality constants

2. Inner-cone type hollow projectile

Inner-cone type hollow projectile (Figure 3a) does not have wave drag at the nose or base drag. In the meantime, since there is no constricted tail, wave drag at the tail also vanishes. If the leading edge at the nose has a certain thickness, then the additional wave drag C'_{DW} still exists and can be computed according to Equation (2). The only difference is that the leading edge now is situated on the outer circle of the projectile and d' in Equation (2) should be replaced by d:

$$C'_{DW} = k\ t/d \tag{7}$$

Frictional drag can still be calculated using Equation (5).

Thus, the formalism for the drag coefficient of the inner-cone hollow projectile can be written as:

$$C_D = 1.10\left\{k_1\frac{t}{d} + \frac{8l}{d}\left(\frac{0.074}{Re^{0.2}} - \frac{1700}{Re}\right)\Big/\left(1 + r\frac{\gamma - 1}{2}M^2\right)^{0.5}\right\} \tag{8}$$

in which the meanings of notations are the same as those given for Equation (6).

III. Analysis of the Gyroscopic Stability

The gyroscopic stability of a spinning projectile can be evaluated with the aid of the gyroscopic stability factor S_g. The projectile is unstable if $0 < S_g < 1$; the projectile is stable if $S_g > 1$ and the greater the S_g, the more stable it is. Ref (2) gives the formula for the gyroscopic stability factor:

$$S_g = \frac{2\omega^2}{\pi\rho d^2 v^2} \cdot \frac{1}{C_{M\alpha}} \cdot \frac{I_x^2}{I_y}$$

where I_x = polar moment of inertia
I_y = equitorial moment of inertia
ω = spin angular velocity
$C_{M\alpha}$ = coefficient of static stability
ρ = density of air
v = flight speed of the projectile
d = diameter of the projectile

For fixed ρ, d, v, and ω, the value of S_g is determined by $C_{M\alpha}$ and I_x^2/I_y. The value of $C_{M\alpha}$ is different for a hollow projectile and for a solid projectile, but we have not investigated its rule of change. We shall now compare the gyroscopic stability of a hollow projectile to that of a regular projectile based on their difference in I_x^2/I_y only. In our analysis, we approximate the regular projectile as a solid cylinder and the hollow projectile as a hollow cylinder, see Figure 5.

Figure 5. Hollow Cylinder

For a solid cylinder, we have

$$I_x = \frac{m}{2}R^2$$

$$I_y = \frac{m}{12}(3R^2+l^2)$$

$$\frac{I_x^2}{I_y} = \left(\frac{m}{2}R^2\right)^2 \Big/ \frac{m}{12}(3R^2+l^2) \approx \frac{3mR^4}{l^2}$$

in which m is the mass of the solid cylinder.

For a hollow cylinder, we have

$$I'_x = \frac{m'}{2}(R^2+r^2)$$

$$I'_y = \frac{m'}{12}(3R^2+3r^2+l^2)$$

where the mass of the hollow cylinder m' is given by $m'=(1-r^2/R^2)m$.

The value of I'_x / I'_y is given by

$$\frac{I'^2_x}{I'_y} = \left[\frac{m'}{2}(R^2+r^2)\right]^2 \Big/ \frac{m'}{12}(3R^2+3r^2+l^2) \approx \frac{3m(R^2-r^2)(R^2+r^2)^2}{R^2l^2}$$

and the ratio of the two is equal to

$$K = \frac{I'^2_x/I'_y}{I^2_x/I_y} = \left(1-\frac{r^2}{R^2}\right)\left(1+\frac{r^2}{R^2}\right)^2$$

Figure 6 shows the variation of the value of k with respect to r^2/R^2.

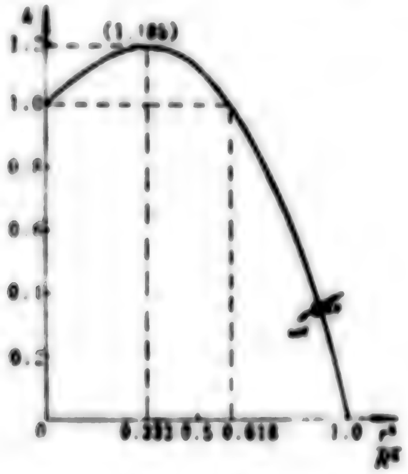


Figure 6. Variation of k as a Function of the Area Ratio r^2/R^2

difficulties of cartridge loading in the shaping process, it is very hard to insure the symmetry of the shaped bullet and defects such as the non-coaxiality of the inner hole and the outer circle and the deviation of the center of mass are present. According to Ref (1), the dispersion accuracy of hollow bullets is very sensitive to the slight variations in geometric parameters. The poor dispersion accuracy in designs I_a and II is therefore understandable.

(2) Accuracy of projectile guidance in the bore

In designs III and IV, control processed 802A is used for the body material that has a hardness (HRC 24 28) comparable to the hardness of the ballistic gun barrel. An inspection of the recovered bullets shows that the rifle knurls are indistinct and the male thread nicks are wider than the male threads of the barrel. This indicates that correct guidance in the bore is not achieved, or, at least there is relative sliding in the guidance process. As a result, the projectiles cannot achieve the designed rotational speed and the flight stability is reduced. More importantly, the consistency of the rotational speed from round to round is poor and accuracy in dispersion is therefore seriously jeopardized.

(3) Initial interference effects (due to the explosive gas after effect and the disengagement interference)

In the testing experiments, we used base structures made of steel. Because the tightness between the body and the base cannot be easily controlled, after the bullet leaves the barrel, the base separates from the body not at the same time, speed and condition. This also affects the dispersion accuracy of the bullets. In designs I~IV, the base weight constitutes a relatively large fraction of the total weight (see Table VIII), and the effects are even greater.

Table VIII. (in percent)

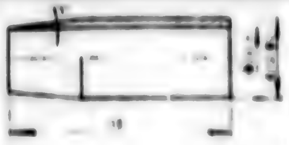
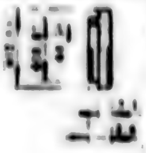
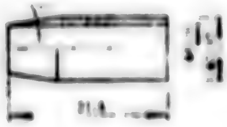
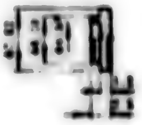
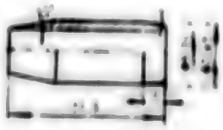
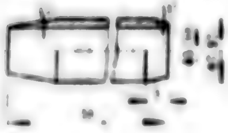
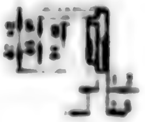
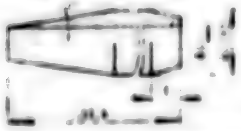
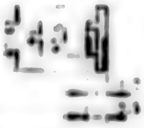
Design	I	II,III	IV	V
Base-to-body weight ratio	22.4	20.0	12.5	5.5

As far as propellant power is concerned, we did not make any specific investigation but simply used what was available. Due to the poor combustion stability, the interference of the explosive gas after-effect is relatively large. Since the body weights in designs I~IV are relatively light, the after-effect influence is large.

(4) Deformation of the projectile body in the bore

When the projectile body strength is inadequate, deformation resulting from the acceleration in the bore also affects the dispersion accuracy. This is the cause for design I_b to have a poorer dispersion accuracy than design V.

Table VI.

[illegible] 2 / [illegible] 1	[illegible] 3		[illegible] 4		[illegible] 5	
	[illegible] 6	[illegible] 7	[illegible] 6	[illegible] 7	[illegible] 6	[illegible] 7
I (I a, I b)			I a, 35CrMnSiA ([illegible])8 HRC45~50 I b, 20[illegible] 10	35CrMnSiA HRC45~50	10.75	2.11
II			35CrMnSiA ([illegible])8 HRC45~50	35CrMnSiA HRC45~50	2.5	0.5
III			802A ([illegible])9 HRC24~28	35CrMnSiA HRC45~50	2.5	0.5
IV			802A ([illegible])9 HRC24~28	35CrMnSiA HRC45~50	4.0	0.5
V			20[illegible] 10	35CrMnSiA HRC45~50	7.4	0.4

Key:
1. Design
2. Features
3. Sketch of the design
4. Material
5. Mass, in grams
6. Projectile body
7. Projectile base
8. Copper plated surface
9. Controlled process
10. Steel

Actually, r^2/R^2 is the area ratio of the hollow projectile. As can be seen from Figure 6, when the area ratio r^2/R^2 is less than 0.618, k is greater than 1 and the gyroscopic stability of the hollow projectile is better than that of a solid projectile. When r^2/R^2 is greater than 0.618, k is less than 1 and the hollow projectile is not as stable as a solid projectile. At $r^2/R^2 = 0.333$, $k = k_{max} = 1.185$ and the hollow projectile is most stable.

It is well known that the gyroscopic stability has important effects on the dispersion accuracy of the projectile: this is especially true for flat trajectories where the "follow" is negligible. Generally speaking, the better the gyroscopic stability, the higher the dispersion accuracy. Thus, k is an important factor affecting the dispersion accuracy of the projectile and should be given proper consideration in the structural design.

IV. Dispersion Accuracy

The major structural design used in the dispersion accuracy tests for hollow projectiles are given in Table VI.

The results of dispersion tests show that design I_b has relatively good dispersion accuracy, comparable to that of regular projectiles; design V has the best performance and its dispersion is only one-half that of regular projectiles (see Table VII). All other designs have rather poor dispersion characteristics.

Table VII.

Type of Projectile	Distance(m)	R_{50}(cm)	R_{100}(cm)	Remarks
Design V	410	8.9	16.1	Model 56 ballistic gun was seriously worn
7.62 mm regular bullet for model 56	410	17.2	43.6	Model 56 ballistic gun was seriously worn
Design I_b	300	8.0	17.0	
12.7mm penetrating-combustive bullet for model 54	300	8.1	16.8	

Based on the experimental results, we now analyze the major factors that have effects on the dispersion accuracy of hollow projectiles.

(1) Manufacture errors of the bullet (especially the asymmetry in shape and deviation of the center of mass)

in design I_a and design II, 35CrMnSiA is used as the body material. The projectile is formed, heat processed, copper plated and finally surface shaped. A certain amount of deformation is resulted from the heat process. Due to

(5) The value of k also affects the dispersion accuracy

The reason that design V has good dispersion accuracy is because of its satisfactory solution of the problems mentioned above. Using No 20 steel as the body material leads to satisfactory guidance in the bore. Since the projectile is formed in one step, the machining error is small. Since the body is relatively heavy, the interference due to the explosive gas after-effect and the base disengagement is small. The thick projectile body insures adequate strength and the value $k = 1.173$ is close to the k_{max} value. The only factor not favorable for a higher dispersion accuracy is its relatively large length-to-diameter ratio λ. A proper reduction of its λ value is expected to decrease the dispersion even more.

Based on the analysis of the experimental results, we believe that, with rigorous design, the dispersion accuracy of hollow projectiles can be made better than that of the regular projectiles.

V. Penetration Effects

The experimental results obtained in some of the designed structures are summarized in the following two tables.

Table IX. Penetration in Steel-Wood Composite Target (Target consists of layers of 25mm thick redwood boards placed behind a 2mm 45 steel plate)

Type of projectile	Kinetic energy (in kg-m) at impact	Penetration depth into the wooden boards P (in mm)
7.62mm light ammunition for model 53	/	150~200 (Projectile nose shell) 200~250 (Steel core)
7.62mm regular ammunition model 56	131	200~250
Design II	120	250~300

Table X. Penetration Through Steel Plates

Type of projectile	Steel plate	Minimum kinetic energy (in kg·m) for penetration
7.62mm regular bullet for model 56	7mm A_3	131
Design II	7mm A_3	86
Design V	7mm A_3	94
7.62mm regular bullet for model 56	2.5mm A_3	47
Design II	2.5mm A_3	20
12.7mm penetrating-combustive bullet for model 54	15mm 2П	882
Design I_a	15mm 2П	890

In addition, we have made observations on projectiles fired into loose targets such as rice bran. When thin-walled, high hardness bullets are fired into the rice bran, the body breaks up into fragments. No fragmentation is observed on thick-walled high strength bullets; the projectile body is found to be filled with extremely dense and hard rice bran.

We can see from the experimental results presented above that the penetration of hollow projectiles is better than that of regular projectiles for thin steel plates, soft steel plates, composite and loose targets. In the penetration of steel plates, the hollow projectile requires only about one-half the kinetic energy of a regular projectile. Moreover, the large hole and the debris generated in the process are favorable for increasing the killing effects. For hard steel plate targets, the hollow projectiles are not favored because the thin-walled hollow structure shatters badly in the penetration process and loses a great amount of kinetic energy.

VI. Analysis of the Potential Ammunition Applications

As described above, hollow projectiles possess some superior characteristics. Their military application, as revealed in experimental investigations, still has a number of technical problems to be resolved.

1. The dilemma of interior and exterior trajectories

Under normal circumstances, the projectile form factor of a hollow projectile is rather small, about one-third or less that of the regular projectile of a similar model. But since the reduction in body mass in the mean time is even greater, the ballistic coefficient increases, the speed maintaining ability in the exterior trajectory decreases, and the long-range ballistic capabilities are adversely affected. If we were to increase the projectile body mass, then the interior ballistic parameters would invariably be affected and the resulting low muzzle velocity would prevent the unique features of this type of projectiles from showing up. Therefore, the projectile shape, weight and other interior and exterior ballistic parameters must all be taken into account in the design and rational choices would have to be made according to the actual requirements of the various types of ammunition.

The dilemma of the range and the power of rifles and machine guns is still a controversial question. If the conviction of reducing the effective range and improving the short range killing effect is valid, then the hollow structure would be more favorable.

2. Manufacture and technical problems

The unique features of the hollow projectile are more pronounced when the area-ratio is large and the drag reduction is good. In choosing an area-ratio, one needs to consider not only the interior and exterior ballistic requirements mentioned above but also the requirements placed on the projectile body strength. Experiments indicate that the strength requirement of a 7.62mm projectile is satisfied when we use an area-ratio of 0.7 and use 35CrMnSiA as the body material. However, copper plating is necessary here in order to insure the proper guidance in the bore. This not only involves complex techniques but the product quality is also difficult to guarantee. In other words, the ballistic properties (especially the dispersion accuracy) may be compromised. With an appropriately decreased area-ratio, regular low-carbon steel can be used as the body material. In our experimental studies we have used No 20 steel to form the projectile body (designs I_b and V), the projectile engages into the rifle lines in the bore directly and the results are satisfactory. We suggest that further investigations should be made and, in the future, impact extrusion techniques may be used in forming the projectile and this should simplify the manufacture process and reduce the production costs.

3. Problems associated with handling and service

After the hollow projectile leaves the muzzle, the projectile base separates from the body due to the air resistance. The separated base continues to fly for a certain distance; for the steel base of a 7.62mm caliber hollow projectile, the distance is about 25-50 m. Since the base does not follow any fixed path, it has a fairly large spread and can pose a certain threat to friendly neighbor troops. Moreover, the sharp leading edges can easily be damaged in the process of packing, loading, and servicing. Those problems should be resolved along the lines of using alternative base material (e.g. plastics) and better structural design.

In summary, we have reached the preliminary conclusion that hollow projectile is a potential new type of projectile which is worthy of further research, especially as a light ammunition for rifles and machine guns.

Results of this study can also serve as references for investigations on large caliber hollow (tube-type) and antitank projectiles.

REFERENCES

1. J. J. Wu, E. R. Sargent, and Robert Berlot, "High Performance Hollow Projectiles," 8 (AD-768907), 1973.

2. "Flight Stability Design for Projectiles," translated by Yang Weizhong [2799 3634 0022], pp 50-52, 1976.

9698
CSO: 4008

FINITE ELEMENT ANALYSIS OF PROJECTILE ELASTOPLASTICITY

Beijing BINGGONG XUEBAO [ARMENTARII] in Chinese No 4, Dec 80 pp 47-53

[Article by Wei Huizhi [7614 1920 0037], Zhu Hesong [2612 7729 2646], Feng Jingyan [7458 2529 5333], and Zhang Shuzu [1728 6615 4371]: "Elastoplastic Analysis of Projectile Under Firing Conditions With Finite Element Method"]

[Text] Abstract

(Received 7 September 1979)

The strength analysis (especially the elastoplastic analysis) of projectiles on firing is one of the problems to be solved in projectile design. It is discussed in this paper with finite element method. A computer model for high explosive antitank (HEAT) projectile is discussed and calculations are made with an axisymmetric elastoplastic program. The results obtained are analyzed and compared with the data of live firings.

I. Introduction

When a projectile is being fired, it is under the action of a variety of loads. To insure the correct motion of the projectile in the bore and to avoid serious premature burst incidents under extreme conditions, the projectile must have adequate strength. However, since the projectile is only good for one firing, excessive strength reserve is not only meaningless but may also have adverse effects on the fulfillment of other strategic and technical conditions. Therefore, accurate analysis of the stress deformation of the projectile and other components is a vital part of the projectile design.

Due to the irregularity of the projectile shape and the complexity of the loads it experiences (see Figure 1), analytical methods can no longer solve this type of problem. In this paper, we have tried using the finite element method in solving the problem. We first performed elastic analysis under low bore pressure for a certain high explosive antitank (HEAT) projectile and obtained preliminary results; then we investigated the finite element plastic analysis for this projectile under high bore pressure and carried out elastoplastic computation with an axisymmetric computer program. Calculated results are compared with the experimental data obtained in about 60 live firings. As a whole the comparison is relatively close.

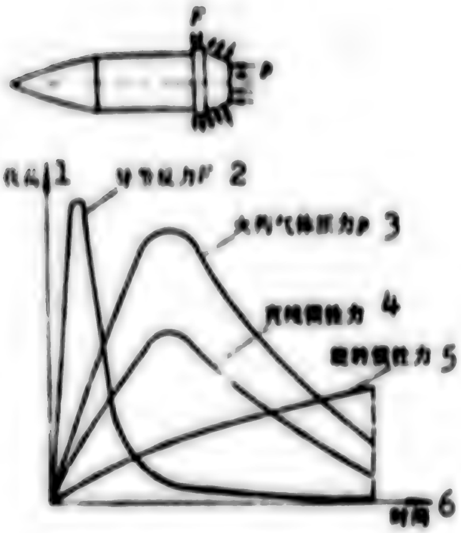


Figure 1. Loads Acting on the Projectile

Key:

1. Load	4. Linear inertial force
2. Rifle reaction force	5. Rotational inertia force
3. Explosive gas pressure p	6. Time

II. Some Explanations

In this paper we used the increment method analysis described in Refs (2) and (3). The meanings of the notations used here are the same as those in Ref (3) unless stated otherwise.

1. About the Weighting Coefficient

In order to increase the accuracy of computation, we used the weighted average in forming the average elastoplasticity matrix $[D_m]$:

$$[D_m] = m\,[D_e] + (1-m)\,[D_{ep}] \tag{1}$$

where m is the weighting coefficient, given by

$$m = \frac{H_{i-1} - \bar{\sigma}_{i-1}}{\bar{\sigma}_i - \bar{\sigma}_{i-1}} = \frac{H_{i-1} - \bar{\sigma}_{i-1}}{\Delta\bar{\sigma}_i} \tag{2}$$

where $\Delta\bar{\sigma}_i$ is temporarily an unknown quantity, it is generally obtained in the first estimation of treating the transition region elements as elastic; then, the computed results are used to improve the value of $\Delta\bar{\sigma}_i$ and after two or three successive substitutions a relatively accurate value of m can be obtained.

2. About the value of H'

For the high strength alloy materials describable by the following power law curve

$$E\epsilon = \sigma + \frac{3}{7}\sigma_{0.7}\left(\frac{\sigma}{\sigma_{0.7}}\right)^{n} \quad (3)$$

where n is the plasticity index (usually from 3 to 30) determined by the material property and $\sigma_{0.7}$ is equivalent to the stress value on the σ-ϵ curve where the tangent slop is 0.7E, the corresponding H' value is

$$H' = \frac{7E}{3n}\left(\frac{\sigma_{0.7}}{\bar{\sigma}}\right)^{n-1} \quad (4)$$

3. About the residual value

The meaning and computation method of the residual value in this paper are the same as that described in Ref (4).

III. Model Analysis and Treatment of Boundary Conditions

Figure 2 shows the loads on the projectile under firing condition. Explosive gas pressure p exerts on the rear of the projectile. In a smooth-bore gun the explosive gas leaks forward through the gap between the cylindrical projectile body and the bore. Following the usual practice, we assume the pressure distribution on the cylindrical part of the projectile to be linear, decreasing from p to zero[1]. The projectile accelerates in the bore under the push of the axial component of the explosive gas pressure. In order to carry out elastoplastic analysis on the projectile, d'Alembert's principle is needed in converting the dynamic problem into a static problem.

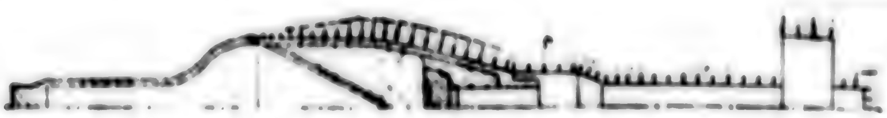


Figure 2. Loads on a HEAT Projectile Under Firing Condition

Since our main interest is in the analysis of the elastoplastic deformation of the projectile body, we have singled out the body and substituted the explosive cover, the fuse, the tail pipe and the tail fin by their corresponding external forces. The simplified calculation model for the projectile body is shown in Figure 3.

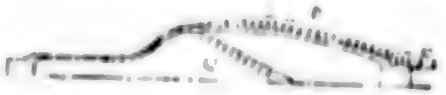


Figure 3. Model of the Projectile Body Used in Elastoplastic Calculations

The following are the major considerations in this model:

1. The projectile body material is taken to be cold-worked high quality low-carbon steel. According to uniaxial tensile measurements made on the sample, the σ-ε curve can be approximated by the power-low hardening curve given by Equation (3). We used the following material data in our calculations:

plasticity index $n = 3$,
elastic modulus $E = 2 \times 10^6$ kg/cm^2,
Poisson's ratio $\mu = 0.3$,
specific gravity $\delta = 7.81$ g/cm^3,
conditional yield limit $\sigma_s = 4000$ kg/cm^2.

2. Since the explosive is regarded to have direct influence on the stress deformation of the body, we have included the explosive in our model but neglected the small effects of other components. The effect of the explosive cover is reduced to an external force.

We treat the explosive as an ideal continuum of elastic medium and assume there is no relative sliding at the boundary of the explosive and the projectile body. The characteristic data of the explosive used in our calculation are as follows:

elastic modulus $E_c = 1.3 \times 10^4$kg/cm^2,
Poisson's ratio $\mu_c = 0.35$,
specific gravity $\delta_c = 1.6$ g/cm^3.

3. In addition to the explosive gas pressure p, there are also the following loads:

The tail pipe exerts an axial force F_2 on the rear end face of the projectile. The value of F_2 can be computed from the following equation:

$$F_2 = p\pi R^2 \left(\frac{q_\omega}{q} - \frac{R_\omega^2}{R^2} \right) \tag{5}$$

where p is the explosive gas pressure, R is the projectile radius, q is the projectile total weight, q_ω is the weight of the tail pipe and R_ω is the radius of the tail pipe.

The explosive cover exerts an inertial force Q on the explosive. Assuming Q exerts a uniform pressure perpendicular to the surface of the conical hole surface, its value is taken to be

$$Q = \frac{4nq_2}{\pi d_2} \tag{6}$$

where q_2 is the weight of the explosive cover, d is the diameter of the conical hole and the overload coefficient n is given by $p\pi R^2/q$.

In addition, there is also the axial inertial force F_n acting on each element of the projectile and the explosive,

$$F_n = nq_n \tag{7}$$

where q_n is the element weight of the projectile body or the explosive.

4. Treatment of boundary displacement condition

In the axial symmetry problem of the finite element computation, in order to prevent the rigid body movement under structural deformation, the axial motion of at least one point must be constrained. In our calculation the bottom surface of the projectile is constrained. F_2 then becomes the constraint reaction force and needs not be treated as a known input to the computer program.

IV. Sample Calculation and Block Diagram of the Program

Sample calculation: Consider the elastoplastic analysis of a thick-walled cylinder experiencing an internal pressure. For the following given conditions:

internal pressure q_o = 2388 kg/cm^2,
elastic modulus E = 2.1 x 10 kg/cm^2,
yield limit σ_s = 2500 kg/cm^2,
inner diameter a = 2 cm,
outer diameter b = 4 cm,
cylinder length l = 0.5 cm,

the calculation results are shown in Table I.

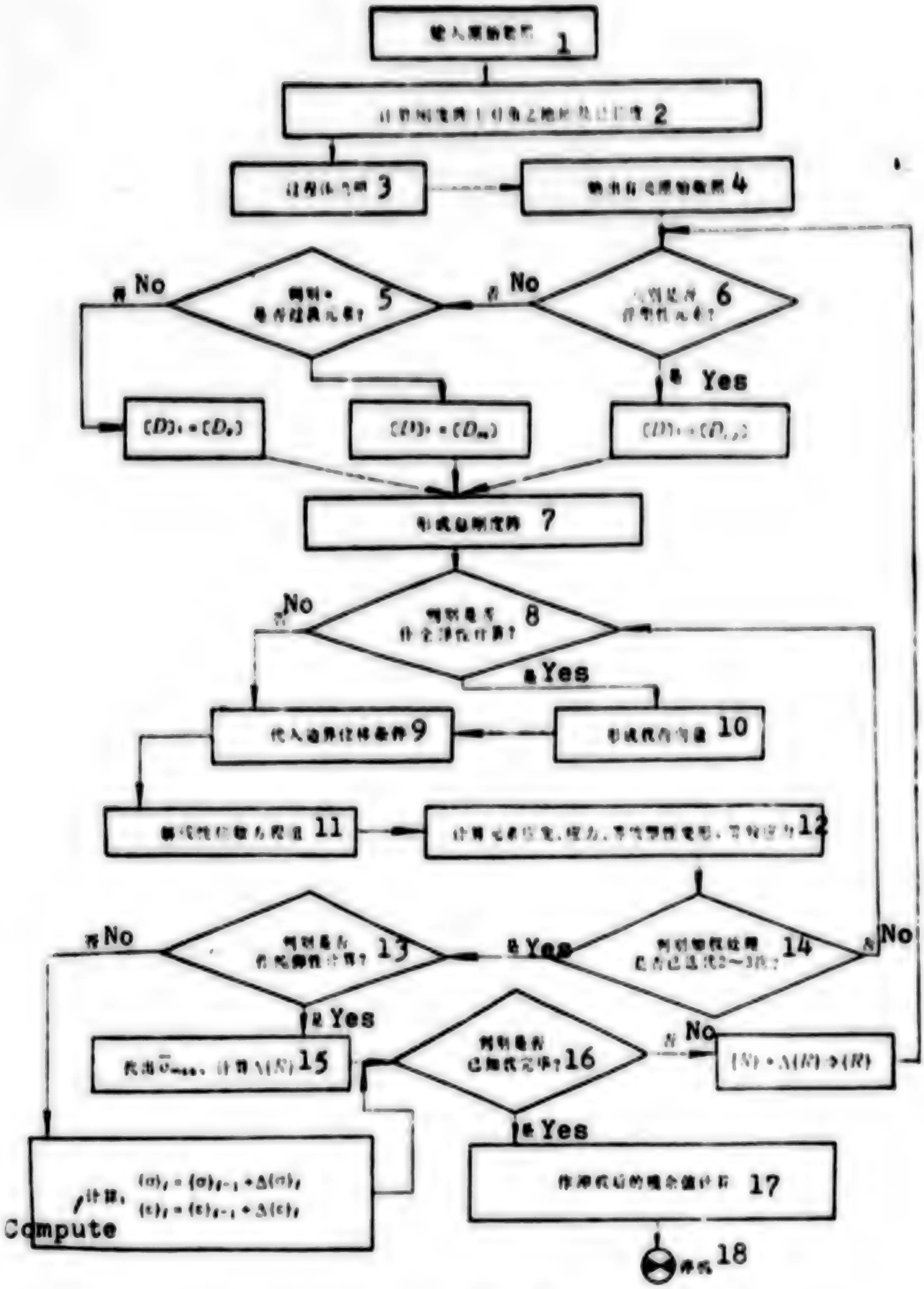
Table I. Circular Stress σ_θ(kg/cm^2) at R = 2.075cm

	Elastic stage q_0 = 589	Plastic stage q_0 = 1619	Total plastic condition	Total plastic critical load	Residual stress
Finite element solution	931	1448	1029	2059	-1989
Classical solution	927	1384	993	2003	

The flow chart of the main program is shown on the next page.

V. Calculation Results and Analysis

In our calculation, we have chosen 382 nodal points and divided the projectile body and the explosive into 609 triangular prismatic elements. Under a static pressure of 500 kg/cm^2, the displacement, stress, strain and residual deformation are computed at various locations of the projectile body and the explosive.



Flow Diagram of the Main Program

Key to Flow Chart:

1. Original input data
2. Calculate the address and total length of the principal diagonal elements of the rigidity matrix
3. Processing and remarks
4. Output of relevant original data
5. Discrimination of transition elements (Transition elements are elements satisfying the conditions $\bar{\sigma}_{i-1} < H_{i-1}$ and $\bar{\sigma}_i > H_{i-1}$)
6. Discrimination of elastoplastic elements
7. Form the complete rigidity matrix
8. Decision for total elastic calculation
9. Substitute into boundary displacement condition
10. Form the load vector
11. Solve the linear algebraic equations
12. Calculate the element's strain, stress, equivalent plastic deformation, and equivalent stress
13. Decide whether to do pure elastic calculation
14. Detect whether weighted average has had 2-3 successive substitutions
15. Find $\bar{\sigma}_{max}$, calculate $\Delta\{R\}$
16. Detect whether loading is complete
17. Perform residual value calculation after unloading
18. Stop

In view of the nature of the d'Alembert's method, we paid special attention to the consistency of the entire load data. The values of the projectile weight, the explosive weight and the overload coefficient are all generated automatically in the computation and they are not fed into the computation from the outside as original data. By doing so, we kept the axial load in precise equilibrium and thus avoided the relatively large errors of local stress and strain at the constraint point due to a transfer of unbalanced force to the constraint point.

1. Displacement and residual deformation

Figure 4 shows the overall displacement at various nodal points after the projectile body is elastoplastically deformed under the loads described above. For the purpose of clarity, the depicted displacement values are magnified many times.

The deformation of the projectile under the action of the explosive gaseous pressure (i.e., the displacement at various points) generally amounts to a slight elongation in the axial direction and, at the tail arc portion under the direct gaseous pressure, there is a radial compression. The maximum deformation occurs at node 246 on the inner surface, that is, 80 mm from the projectile bottom surface (excluding screw threads). This result is in agreement with that obtained using semiclassical (LaPlace) formula and it is also consistent with the experimentally measured value.

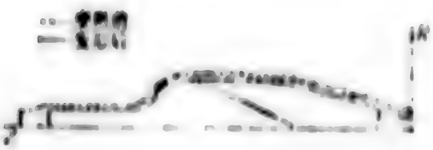


Figure 4. Deformation of the Projectile Body

Key: 1. Before deformation 2. After deformation

Under the conditions of $p = 500$ kg/cm^2 and $\sigma_s = 4000$ kg/cm^2, the body material begins to yield and the residual deformation is relatively small. The residual radial displacement of the outer surface of the tail arc is shown in Figure 5. As can be seen, the maximum residual deformation also occurs at a distance 80 mm from the bottom surface

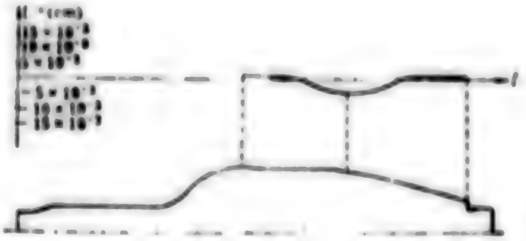


Figure 5. Radial Residual Deformation of the Outer Surface at the Tail Arc

Table II shows the total displacement and residual displacement of some nodal points in the region of maximum displacement (as shown in Figure 6).

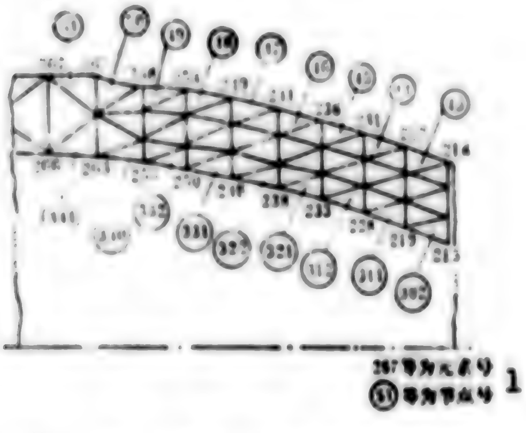


Figure 6. Some Selected Elements and Nodes

Key: 1. Numbers such as 267, 266 ······· refer to elements and circled numbers such as (51) refer to nodes.

Table II

[illegible] 1	[illegible] (mm) 2	[illegible] 3	[illegible] (mm) 4	[illegible] (mm) 5	[illegible] (mm) 6	[illegible] (mm) 7
8 外表面	73	218	-0.081	0.064	-0.00393	0.00148
	75	222	-0.083	0.065	-0.00407	0.00151
	77	231	-0.086	0.065	-0.00414	0.00156
	79	236	-0.087	0.065	-0.00414	0.00157
	81	241	-0.088	0.066	-0.00404	0.00157
	83	249	-0.088	0.066	-0.00385	0.00156
	85	253	-0.087	0.065	-0.00357	0.00151
	87	258	-0.086	0.065	-0.00323	0.00153
	89	263	-0.084	0.065	-0.00276	0.00141
9 内表面	73	213	-0.087	0.062		
	75	219	-0.088	0.063		
	77	226	-0.089	0.064		
	79	233	-0.090	0.065		
	81	238	-0.091	0.065		
	83	246	-0.091	0.066		
	85	250	-0.090	0.067		
	87	255	-0.089	0.068		
	89	263	-0.087	0.068		

Key:
1. Surface
2. Distance to the bottom surface (mm)
3. Node number
4. Total radial displacement (mm)
5. Total axial displacement (mm)
6. Residual radial displacement (mm)
7. Residual axial displacement (mm)
8. Outer surface
9. Inner surface

2. Stress

Figure 7 depicts the distribution curve of the equivalent stress $\bar{\sigma}$ at the inner surface of the cylindrical part and the tail arc of the projectile body. The maximum equivalent stress occurs at element 322: $\bar{\sigma}_{max}$ = 4418 kg/cm², when σ_x = -798 kg/cm², σ_r = -115 kg/cm², σ_θ = -4834 kg/cm² and τ_{xr} = -4.8 kg/cm².

The stress values of some elements in the maximum stress area are shown in Table III.

Table III.

[illegible] 1	[illegible] 2	$\bar{\sigma}$ (kg/cm²)	σ_x (kg/cm²)	σ_r (kg/cm²)	σ_θ (kg/cm²)	τ_{xr} (kg/cm²)
3 内表面	[illegible]	[illegible]	1046	-197	[illegible]	-113
	[illegible]	[illegible]	[illegible]	-187	[illegible]	[illegible]
	312	[illegible]	[illegible]	-150	4682	62
	[illegible]	[illegible]	-855	-131	[illegible]	37
	[illegible]	[illegible]	-798	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	-781	[illegible]	[illegible]	18
	[illegible]	[illegible]	-780	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	-123	[illegible]	[illegible]
4 外表面	[illegible]	[illegible]	[illegible]	151	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	161	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	-178	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	-4831	194
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	1255	-459	[illegible]	[illegible]

Key: 1. Surface 2. Element number 3. Inner surface 4. Outer surface

Stresses at the interior of the explosive are far less than those at the projectile body. This is because the explosive has a much smaller elastic modulus than the body. For example, element 400 at the bottom of the explosive has a $\bar{\sigma} = 69$ kg/cm^2.

3. Comparison of calculated results and experiments

The dynamic measurement of the projectile under firing conditions is a very complex task, especially under high bore pressure. Currently, the principal method uses live firing in which the firing strength of the projectile is evaluated and inspected by measuring the residual radial deformation at a few specific cross sections on the recovered projectile. Since there are many random factors in this type of measurement, there may be fairly large scattering in the data even under identical conditions of firing. Thus, it is only meaningful to compare the calculated results with such experimental data on a statistical basis. Here we have taken the statistical average of a large number (about 60) firings and the strength evaluation obtained in these live firings is then compared with the calculated results. The comparison is shown in Table IV.

Table IV.

<table>
<tr><th colspan="2">Residual deformation of the outer surface at a distance of 80 mm from the projective bottom surface</th></tr>
<tr><td>Measured value in live firing
-0.00995cm</td><td>Computed value using finite element method
-0.00808 cm</td></tr>
<tr><td>(Statistical average of 60 firings)</td><td>(Corresponding to the results after two successive substitutions of the weighted coefficient m.</td></tr>
<tr><td colspan="2">Relative error 18.7 percent</td></tr>
</table>

VI. Conclusions

Based on the analysis and the computation results described above, one can see that the calculated stress distribution and the deformation of the projectile are both reasonable and compare favorably with the experimental data.

In our calculation the explosive is treated as a continuum of an elastic medium. Actually the explosive charge in the projectile is press-formed from crystalline grains of explosive material; it is perhaps more appropriate to treat it as a visco-elastic medium.

It should be pointed out that there are technical problems in measuring the projectile deformation under firing. Since there are relatively large errors in the deformation values measured in the live ammunition firings, more meaningful comparisons will have to be made with more accurate experimental data in order to judge the validity of the finite element elastoplastic analysis.

Acknowledgement

This work has benefitted from the consultation with Professor Ouyang Chang [2926 7112 7598] of Fudan University. The authors express their appreciation.

REFERENCES

1. Hua Gong [5478 1872] and Ou Liner [2926 2651 1422], "Function and Design Theory of Projectiles," Defense Industry Press, 1975.

2. Li Daqian [2621 1129 3383] et al, "More on Finite Element Method," Scientific Press, 1979.

3. C. S. Desai and J. F. Abel, "Introduction to the Finite Element Method," Van Nostrand Reinhold Co., New York, 1972.

4. R. Hill, "Mathematical Theory of Plasticity," Chinese translation by Wang Ren [3769 0088] et al, Scientific Press, 1966.

5. Kyuichiro Washizu, "Theory of Plasticity," Chinese translation by Liu Yiheng [0491 0076 3801], Shanghai Science and Technology Press, 1961.

6. Mathematics Department, Fudan University, "Selected Talks on Finite Element Method," Scientific Press, 1976.

9698
CSO: 4008

NEW CANCER INJECTION DRUG FOUND SUCCESSFUL

Shanghai JIEFANG RIBAO in Chinese 3 Dec 80 p 1

[Text] A new effective anticancer injection drug--anaerobic Clostridium claviformis vaccine--has been successfully made by the Scientific Research Cooperative Group organized by the Shanghai Institute of Biological Products, Municipal Hospital No 3, Municipal Tumor Hospital, Municipal Chest Hospital, and others. Its treatment effect is obvious. Yesterday, scientific and medical researchers of 52 organizations came from eight provinces and cities to attend the meeting on technical certification of the anticancer injection drug. Clinical application of this anticancer injection drug in 17 organizations of the region of Shanghai on 364 patients with more than 20 diseases, including late stage lung cancer and rhinopharnygeal cancer, indicates that it can prolong the survival period and survival rate of tumor patients and has the advantages of being safe and producing good effects. Shanghai People's Hospital No 3 used it to treat 51 cases of malignant hydrothorax caused by metastasis of lung cancer and other forms of cancer by injecting the drug into the pleural cavity. The effect was obvious in 96 percent of the patients. Of these, 48 patients had not had chemotherapy and were injected with the drug one to four times, and the hydrothorax receded in 85 percent. One of them was suffering from maligant lymphoma and had had a total of 30,000 milliliters of chest fluid pumped out on more than 30 occasions. After he was injected with the drug, the chest fluid was immediately controlled and absorbed. The Tumor Hospital used the drug in combination with the cryosurgery technique. Of the 37 patients thus treated, clinical examinations found 30 percent no longer suffering from tumors, and in 60 percent of them the tumors had shrunk to half the original size, the tumor growth had been suppressed and the condition of the disease had been stabilized.

The Ministry of Public Health, leaders and scientific researchers from other provinces and cities believe this drug and related research work are very important in the treatment of tumors. The Shanghai Institute of Biological Products, which is responsible for producing this vaccine in this city, is trying hard to develop all its potential to start official production of this drug as soon as possible in order to meet the needs of medical treatment units and patients.

6248
CSO: 4008

LIFE SCIENCES

BRIEFS

DRUG PRICE READJUSTMENT--According to JIANKANG BAO [HEALTH NEWS] the Ministry of Finance, the State Bureau of Prices, and the State Bureau of Pharmaceuticals Management have issued a joint announcement adjusting the prices of 268 drugs nationwide. The prices of 156 drugs are reduced, and those of 112 drugs are appropriately raised. The new prices are to be implemented as follows: The factory prices and the wholesale prices are applicable on 10 November and the retail prices on 10 December. In some areas, due to the late arrival of documents, the adjustment of the sale prices may be delayed, but the new prices must become effective before the end of the current year. According to the tables provided by the department in charge, the current price indexes for drugs show a reduction of more than 80 percent compared with the early years after liberation. The principle of this adjustment is to maintain stability of the market prices of drugs and to reduce the average drug prices. Among the adjusted items, the prices of most common drugs are reduced, with a relatively large reduction in retail prices. For example, the price of 250,000 unit sugar-coated tetracycline tablets is reduced from 5 fen [100 fen to a yuan] to 3.5 fen each, that of Anacin tablets from 2.5 fen to 2 fen, those of phenyramidol and Santoninum tablets from 2 fen and 2.5 fen to 1.3 fen and 1.8 fen respectively. The increase in the prices of the items scheduled for a price increase is not very great. The overall price readjustment amounts to a net reduction of about 10 percent. [Text] [Beijing GUANGMING RIBAO in Chinese 31 Dec 80 p 1] 6248

SEMISYNTHESIZED DRUG FOR LEUKEMIA--A semisynthesized Cephalotaxinine certification conference was held by the Ministry of Public Health 9-12 December 1980 at the Hainan Island Troop 187 Hospital. The conference studied the clinical treatment condition of 172 cases of leukemia using this drug and concluded that the treatment effect of this drug is basically the same as that of natural Cephalotaxinine. It is a relatively good new drug for treating acute nonlymphocytic leukemia (cancer of the blood). On the basis of confirmed clinical effectiveness of natural Cephalotaxinine, the ineffective residue of Hainan Cephalotaxus hainanensis after Cephalotaxinine has been extracted is used as the raw material to carry out artificial semisynthesis in order to produce semisynthesized Cephalotaxinine in a chemical procedure. As Cephalotaxinine is limited by the plant resource, the Institute of Pharmacology of the Chinese Academy of Sciences began to carry out the semisynthesis research in 1973 in order to meet the clinical demand for this drug. The project was first successfully completed in June 1975. Since then, the 187 Hospital, Shanghai Pharmaceutical Plant No 12, Wuhan College of Medicine Hospital No 1, and 10 other organizations joined forces with the Institute of Pharmacology to carry out chemical, pharmacological, clinical, and test production studies and success was achieved in all cases. The certification conference regards this type of production procedure for semisynthesized drugs as feasible and it may be expanded and extended in the future. [Text] [Beijing GUANGMING RIBAO in Chinese 31 Dec 80 p 1] 6248

CSO: 4008

PUBLICATIONS

TABLE OF CONTENTS OF 'HUAZHONG GONGXUEYUAN XUEBAO' NO 3, 1980

Wuhan HUAZHONG GONGXUEYUAN XUEBAO [JOURNAL OF HUAZHONG INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 80 preceding p 1

[Text] An Investigation on Multiple Faults Testing in Combinational Circuits by Boolean Differential Algorithm...... Lu Jiandong [7120 1696 2639] (1)

Mathematical Simulation and Physical Simulation of the Helicopter Control System......Chen Caikan [7115 2624 0170] (9)

A Numerical Method for Calculating Ship Rudder Coefficients ......Liang Shufen [2733 3219 5358], Xu Hanzhen [6079 3352 3791] and Sun Yibing [1327 0076 0365] (23)

An Optimum-Direction-Search Method for Two-Dimensional Unconstraint Optimum Problems......Yun Tianquan [7189 1131 6898] (33)

The Calculation of Continuous Rectangular Plates Arbitrarily Supported at Their Two Opposite Edges......Huang Yuying [7806 3768 4134] (41)

The Spline Function Method for the Calculation of Beams...... Luo Hui [5012 6540] (51)

A Study of the Calculating Method for Double-Disk Friction Screw Press......Jiang Xixian [5592 1585 6343], Liu Xiefang [0491 0588 5302] and Duan Chunling [3008 2504 3781], et al. (57)

A Graphical Analysis of Speed of Belt and Belt Pulley in Belt Transmission......Wang Kun [3769 2492] (71)

A Mathematical Model of Automatic Forging in Hydraulic Press with Flat Tool......Xiao Jingrong [5135 2529 1369] and Huang Zhenxun [7806 6690 1789] (75)

A System with Multiple-Field Cumulation and Image-Difference Processing for the Signal from a Pyroelectric Vidicon...... Huang Tiexiu [7806 6993 0204] and Tan Xinquan [6151 2450 2938] (83)

On Multiple-Frequency Acousto-optic Bragg Diffraction......Ye Jiaxiong [5509 0857 7160] (93)

The Principle of Vision and Technique of Narrow Spectrum and Pulse......Lei Shizu [7191 1709 4371] and Lei Guozu [7191 0948 4371] (103)

The Series Formula and Trigonometric Function Formula for Tooth Harmonic e.m.f. of Synchronous Machine......Ren Yuan [0117 0337] (113)

The Effect of Arc Velocities between Oxidized Electrodes in Transverse Magnetic Fields......Cheng Lichun [4453 4409 2797] and Xie Jiazhi [6200 1367 3112] (121)

The Determination of Feedback Matrix and Weighting Matrix for Optimum Control According to Stability Requirements......Cheng Guangbi [4453 0342 1732], Ren Yuan [0117 0337], Sun Yangsheng [1327 2254 5116] and Zhang Yongli [1728 3057 4539] (129)

An Approach to a Servosystem through Digital Phase Control ......Hu Yaguang [5170 0068 0342] and Chen Mianyun [7115 4875 0061] (137)

An Automatic Control System of the Ship Diesel-Generator Power Station......Zhou Qiubo [0719 4428 3134], Jin Songling [6855 2646 0109], Xiao Yunfu [5135 6663 4395] and Xu Zhixin [1776 5267 2450] (141)

Reliability of NC Systems and Utilization Coefficient of NC Machine Tools......Tang Yonghong [0781 3144 3163] (149)

The Measurement of Short-Circuit High-Current......Liu Yanbing [0491 1693 0393], Huang Guanbin [7806 0385 2430] and Zhu Mingjun [2612 2494 6874] (163)

The Jet Path in a Cross Stream......Pan Yanqiang [3382 5888 1730] (171)

A Preliminary Study of Atomizer with a Central Jet......Li Fujin [2621 0154 6855] (177)

The Modeling Law of the Hydraulic Modeling Test of Jacket Spray Type Desuperheater......Lin Zhijie [2651 1807 2638] and Rong Luanen [1369 7019 1869], et al. (183)

An Experiment on the Hydraulic Behavior of Jacket Spray Type Desuperheater......Rong Luanen [1369 7019 1869], Lin Zhijie [2651 1807 2638], Liu Yousong [0491 2589 3247] and Huang Weihe [7806 4850 7729], et al. (189)

An Analysis of "The Hydraulic Test Results of Five Blade Axial Hydraulic Turbine for Project 330"......Cheng Liangjun [4453 5328 7486] (199)

The Poly-Aluminum Chloride (PAC) and the Alumina Used for Investment Casting Gears......Wang Weicong [3769 4850 5115] and Shen Qiwen [3088 0366 2429] (209)

9717
CSO: 4008

PUBLICATIONS

TABLE OF CONTENTS OF 'DIANLI XITONG ZIDONGHUA' NO 6, 1980

Nanjing DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER SYSTEMS] in Chinese No 6, Dec 80 preceding p 1

[Text] The Arrangement of Measuring Instruments Using State Estimation in Electric Power Systems......Wen Hening [3306 0735 1380], Chengdu University of Science and Technology (1)

Analysis of Real-time Control for Active Impact Load in Power Systems......Wu Jiayu [0702 1367 6877], Design Department of Electric Power in Southwest China (11)

Influence of Station-to-Earth Capacitance on PLC Wave Traps ......Zhang Dianmo [1728 0368 6206], Shenyang Technical School of Electric Power (19)

How to Select the Setting of the Ground Distance Relay...... Xu Jingxian [6079 2417 6343], Nanjing Automation Research Institute (30)

A Study of Fault Analysis Using Two Vector System Symmetrical Components......Shi Shiwen [0670 0013 2429], Nanjing Institute of Technology (38)

Application of DJS-17 Computer in a Hydroelectric Power Station......Guangdong Power Laboratory (51)

Anti-interference Strategy of Protective Relaying System for Series Capacitance Compensator......Liu Jingzhou [0491 6975 0719], Fushan Prefecture Power Company (55)

Precise Setting of Transistorized Time Relay......Ma Shimo [7456 1597 2875], Nanjing Automation Research Institute (59)

A Drum Storage System Designed with Self-correcting and Self-rereading-rewriting Functions......Ma Hejun [7456 0735 6874], Nanjing Automation Research Institute (63)

JL-500 Zero-Sequence Directional Current Protective Device ......Chen Yingrong [7115 6601 2837] and Ding Gonghua [0002 0501 5478], both of Nanjing Automation Research Institute (68)

Automatic Monitoring and Control of Power Systems (serial). 4. Economical Operation of Power System and Quality Control of Electrical Energy (II)......Han Zhenxiang [7281 4394 4382], Zhejiang University (70)

Computer Programming for Beginners (Serial). 6. Approach Method......Fu Hongcang [0265 7703 0221] (79)

9717
CSO: 4008

PUBLICATIONS

TABLE OF CONTENTS OF 'DIANLI JISHU' NO 12, 1980 AND NO 2, 1981

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 12, 5 Dec 80 and No 2, 5 Feb 81

[No 12, 5 Dec 80 p 64]

[Text] Energy Conservation Topics

Operating Experience of Condensing Turbine under Reduced Vacuum......Ye Riquan [5509 2480 3123] (1)

Analysis of Utilization of Circulating Water for General Heating Purposes by Reducing Turbine Exhaust Vacuum...... Huang Rixin [7806 2480 2450], Hebei Electric Power Survey and Design Institute (7)

Improvement of Steam Systems for Small Power Plants...... Chen Xuesheng [7115 1331 5110], Dongyu Power Plant, Wenzhou (10)

Application of Infrared Photography in Electric Power Industry ......He Qianyuan [6320 3383 3293], Liu Changjiu [0491 7022 0036] and Hou Shanjing [0186 0810 2417], all of the Xian Thermal Engineering Institute, Ministry of Electric Power (14)

Hydrogen Damage of Boiler Wall Tubes in Thermal Power Plants ......Li Bing [2621 0365], Northeast Electric Power Testing and Research Institute (17)

Improvement of Reliability of the Seal of Thrust Balancer of Feed Water Pumps......Wang Weiqian [3769 4850 0051], Jilin Thermal Power Plant (21)

Special Features of Pneumatic Ash Removal at Gaojing Steam Power Plant......Jiang Xuedian [5592 1331 0368], Beijing Electric Power Design Institute (24)

Measurement of Capacitive Current under a Single Phase Ground Fault......Zhu Zhongming [2612 0112 7686], Central Laboratory, Xuzhou Electric Bureau (28)

Allowable Value of Circuit Breaker Contact Resistance under Low Loads......Wang Baimei [3769 4101 4168], Xian High Voltage Switch Plant (33)

Application of Modified Bridge Current in Hotline Measurements ......Xu Bingtian [1776 4426 1131], Tangshan Power Bureau Repair and Testing Laboratory (35)

Passing of Steam through the Concrete Structures during Construction in Winter......Shu Zhuoqun [5289 0587 5028], Jilin Thermal Power Engineering Company (37)

Stringing of H.V. Transmission Line by Marking Its Length at Ground Level......Ji Weiping [1323 4850 1627], Yangzhou Electric Bureau (41)

Calculation of Network Power Losses Based on the Registered KWH......Xiao Yuankai [5135 0337 1956], Jilin Institute of Technology (45)

Innovation

Determination of Acid Concentration during Hydrochloric Acid Cleaning of Boiler......Yu Hongen [0151 7703 1869], Central Laboratory, Guangdong Bureau of Electric Power Industry (49)

Installation for Removal of Crushed Balls during Ball Mill Operations......Liu Jiaxiang [0491 1367 4382], Huainan Power Plant (49)

Preheating Air by Using Wasted Heat of Boiler Flue Gas...... Sui Guoliang [4242 0948 5328], Xinkai Chemical Plant (50)

Optimum Assembly Angle for Motor-operated Actuating Links...... Zhang Hongshen [1728 1347 4800], Xiahuayuan Power Plant (50)

Use of Steel Mold Casing on 500 KV Line Tower Foundations...... Qin Shuxian [4440 5289 7359], Henan Electric Power Construction Office No. 5 (52)

Protection of Power [illegible] against Fault Current Surges ......Yang [illegible] [2799 1585 2638], Zhengzhou Power Bureau (53)

The Innovations in Civil Engineering Works of Baoshan Steam Power Station......Wang Kefa [3769 0344 3127], Technology Office, Electric Power General Construction Bureau (54)

[illegible] Brief

[illegible] "[illegible]" Activities of Electricity [illegible]...... (55)

Seminar for Experiences with Modifications of Feed Water Pumps for Large Generating Units...... (56)

Topics from Abroad

Telemetering and Communication in the CEGB Grid......Li Liezhong [2621 3525 1813], Chengdu University of Science and Technology (57)

CIGRE Press Communique: The Effects on Man of Electric Fields under Lines...... (62)

[No 2, 5 Feb 81 p 80]

[Text] Construction of Underground Coal Conveyor Duct by Using Tunneling Method......Text by Zhou Di [0719 2769], Technology Section, Eastern Power Company No 3 (1)

Design of Cylindrical Coal Bunker and Analysis of Some Relevant Problems......Liu Jinshui [0491 6855 3055], Northwest Electric Power Design Institute (7)

Modification of Impact Plates of Ventilator Type Pulverizer...... (11)

Application of Laser Level with Wavestrip Plate in Steam Turbine Alignment......Luo Cian [5012 2945 1344], Hubei Electric Power Engineering Company (16)

Tests on Fast Valving of Steam Turbines in Improving System Stability......Xiao Qifu [5135 0796 1381] and Pi Jianguo [4122 1696 0948], both of Shanxi Electric Power Testing and Research Institute (19)

Problems in Remote Information Treatment Program for Power Systems......Yin Gengsheng [1438 2577 3932], Xian Jiaotong University (25)

Grounding System for the Power Plant of Baoshan Steel Works ......Shi Zhennan [4258 7201 0589], Baoshan Steel Company, Shanghai (30)

Detection of Ground Fault on DC Branch Circuits with AC Source......Chen Ziqi [7115 1311 1142] (34)

Measurement of Grounding Resistance and Earth Resistivity...... Li Yushi [2621 3558 0528], Wuhan Electric Power Design Institute (36)

Calculation of Flexible Busbars in Outdoor Substations...... Tan Hongxun [6151 1347 0534], Datun Power Plant (40)

Synopsis of Papers

A Synopsis of the Symposium on the Operation of Steam Generators in Thermal Power Plant (Part Two)...... (45)

Discussions

Measures for Regulation of Peak Load and Its Economic Analysis ......Zhu Tai [2612 3141], East China Power Industry Management Bureau (51)

Topics from Abroad

Erosion Caused by Ash Particles in Coal-fired Boilers...... (55)

Consider Foam Cleaning for Turbines...... (61)

Technical Progress of Switching Equipment and Its Application ......Gan Chengze [3927 3397 3419] (64)

Partial Discharge Measurement with Video Amplifier or Supersonic Detector...... (69)

Technical News

New Geothermal Technique Tested...... (71)

Investigations into the Effect of pH Value on Brass Corrosion...... (60)

Protecting Metals against Abrasion...... (44)

Cut Failures by Analyzing Transformer Oil...... (72)

Line Maintenance by Remote-Controlled Device...... (72)

Innovations

Improvement of Martin's Ash Crusher for 35t/h Boilers...... Feng Keliang [1756 0344 0081], Zhangye Power Plant, Gansu (73)

Installation and Adjustment of Vibrating Coal Feeder...... (73)

Some Causes for Dissolved Oxygen in Condensate...... (75)

Field Welding Stops Leaks in Older Power Transformers...... (75)

Conference Briefs

Conference on Engineering and Design of Representative Power Plant Projects...... (77)

EHV Transmission System Seminar...... (79)

9717
CSO: 4008

PUBLICATIONS

TABLE OF CONTENTS OF 'HE JISHU' NO 1, 1981

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 1, 1981 preceding p 1

[Text]

The Theoretical Basis of Small Molecule Radioimmunoassay......Rong Kangtai [2837 1660 3141], Academy of Military Medical Sciences and Institute of Pharmacology and Toxicology (1)

Radioimmunoassay of Progesterone......Cao Meixun [2580 2734 6061], Liang Suxiang [2733 4790 7449] and Dong Xiaoqin [5516 2556 3830], all of the Shanghai Institute of Cell Biology, Chinese Academy of Sciences (11)

The Measurement of Absolute Intensity of Medical Isotopes ^{131}I and ^{198}Au by Efficiency Extrapolation Method......Zhu Jiabi [2612 1367 3880], Liu Jingyi [0491 7234 1837], Lu Shangnu [0712 1424 1166] and Gu Jiahui [7357 0857 6540], all of the Shanghai Institute of Nuclear Research, Chinese Academy of Sciences (16)

The Measurement of Phosphorus Contained in the Semiconductor Device......The Group for Nuclear Reaction Analysis [Text by Bao Xiumin [7637 4423 2404]] (21)

Graft Polymerization of Methacrylic Acid-Divinylbenzene from Its Aqueous Solution with Pro-irradiated F_{46} Film......Wang Hanying [3769 0698 5391], Ni Minhua [0242 3406 5478] and Xu Zhili [6079 1807 4539], all of the Shanghai Institute of Nuclear Research, Chinese Academy of Sciences (26)

Absolute Determination of Exposure for 60～250 Kilovolt X-rays ......Liu Shulin [0491 2885 2651], Zhang Limin [1728 0448 3046], Wang Lingzhen [3769 3781 3791] and Zhou Zhigen [0719 1807 2704], all of the Shanghai Institute of Testing Technology (31)

Proton Activation Analysis for Nitrogen in Ta and Nb...... Lin Senhao [2651 2773 3185], Bao Jinrong [7637 6930 2837] and Zhang Jiading [4545 1367 7844], all of the Shanghai Institute of Nuclear Research, Chinese Academy of Sciences (38)

A Quartz Oscillation Monitor for Control of Film Thickness...... Yin Jianhua [1438 1696 5478], Lanzhou Institute of Modern Physics, Chinese Academy of Sciences (41)

Concentration and Separation of Noble Metals of the Chelating Resins--The Investigation of Adsorption Behavior of Ir^{IV}, Rh^{III} in HCl Medium Using Radioactive Indicators......Zhuang Guisun [5445 0964 5549], Qian Yine [6929 6892 1230] and Hua Zhifen [5478 5347 5358], all of the Shanghai Institute of Nuclear Research, Chinese Academy of Sciences (44)

The Measuring and Theoretical Estimation of Exposure in a 150,000 g.Ra.eq. Extended Radiation Source......Chen Jingzhong [7115 2417 1813] and Mu Changyun [3664 7022 0061], both of the Chengdu Health and Epidemiology Station (47)

9717
CSO: 4008

AUTHOR: Jichunhe Jiyan [transliteration of Japanese name]

ORG: Xiaoyantian [transliteration of Japanese name] Cement Company

TITLE: "Experiment With Burning Pulverized Coal in RSP System"

SOURCE: Beijing SHUINI [CEMENT] in Chinese No 1, 10 Jan 81 pp 10-12

ABSTRACT: In 1974-75 and in 1977, the Tianyuan [transliteration of Japanese name] Experimental Plant of Xiaoyantian Company carried out 3 experiments on burning pulverized coal in order to determine the basic data for eddy current furnace design, the number and the positions of jet nozzles, and characteristics of coal. During the experiment, the eddy current furnace was coal fired but the kiln was oil fired; this was due to the fact that there had been experience about coal fired kiln and experiment was no longer necessary. Compared with oil, coal burns slower while the decomposition reaction of the raw material absorbs a large quantity of heat to cause the temperature to drop quickly and to further reduce the burning speed of coal. The paper concludes that burning coal in the RSP system remains possible to succeed. Reasons are given to support the conclusion. The first coal-fired RSP process line will be placed in operation in the USA in the spring of 1980. This paper is translated from Japanese by LA Huapu [0812 5478 3877] of Liuzhou Cement Plant [Guangxi Province.]

AUTHOR: LUO Zhenhua [5012 2182 5478]
TIAN Qingfang [3944 1987 5364]

ORG: None

TITLE: "Experiment on The Use of Low Silicon Clay to Produce Superior Quality Silicate Cement"

SOURCE: Beijing SHUINI [CEMENT] in Chinese No 1, 10 Jan 81 pp 36-41

ABSTRACT: The major mineral in silicate clinker is $C_3S + C_2S$. For the purpose of improving the strength of clinker, while causing it to forge normally in the kiln, there must be sufficient CaO in the chemical composition of the clinker and also sufficient SiO_2 (20-22 percent) to react with CaO, and at the same time the silicate rate in the clinker must be controlled in a proper range (n =2.0 - 2.1.) For this reason, the silicate rate in the clay raw material should be 2.7 - 3.5 percent. If the silicate rate is lower than this (2.0 - 2.7 or lower) silicon material (sandstone or silt) must be used to correct the deficiency. For the purpose of resolving the source of materials for the cement industry, the authors carried out a series of experiments on using clay of low silicon content to produce superior quality silicate clinker by adjusting the raw material design, controlling the production process, etc. These experiments are reported.

AUTHOR: LU Chunxuan [7120 4783 3551]

ORG: Senior Engineer, Institute of Cement, Research Academy of Construction Materials

TITLE: "Present Condition and Future Prospect of Research, Manufacture, and Extension of Lining Materials for Cement Kilns"

SOURCE: Beijing SHUINI [CEMENT[IN Chinese No 2, 10 Feb 81 pp 2-8, 14

ABSTRACT: In the past, the useful life of the lining materials of cement kilns was very short in China, less than 1/8 of that of West Germany and less than 1/5 of that of Japan, and only 1/3 of that of the USSR. Unit consumption of bricks was therefore high, 5 times of that of West Germany and 1.5 times that of the USSR. Special research team was organized to tackle this problem. Domestic production agencies and resources for refractories joined forces to produce 4 types materials suitable as kiln lining materials for different temperature zones, including phosphate bound aluminum brick, phosphate bound aluminum abrasion resistant brick, sodium polyphosphate bound magnesium brick, and sodium silicate bound magnesium brick. Extension of these materials has begun in 1978, and 6000-7000 tons of magnesium-chromium bricks and sodium silicate bricks, and 10,000-11,000 tons of phosphate bricks have been delivered to the various large and medium cement plants and the useful life of lining materials have begun to be close to the 1974 level of the USSR. The processes of research, manufacture, and extension of these lining materials are reported.

AUTHOR: None

ORG: Jiangshan Cement Plant

TITLE: "Test Use of Magnesium Bricks in the Firing Zone of the Rotary Kiln"

SOURCE: Beijing SHUINI [CEMENT] in Chinese No 2, 10 Feb 81 pp 9-11

ABSTRACT: Under the direction of the Research Academy of Construction Materials and with considerable help from Shenyang Municipal Refractory Material Plant, 6.49m and 5.98m of sodium polyphosphate magnesium bricks, sodium silicate magnesium bricks, magnesium chromium and magnesium aluminum bricks were laid in the 2 ∅3 x 88.65 wet method rotary kilns of Jiangshan Cement Plant. New records of useful life at the plant was thus created. This paper reports the economic efficiency of magnesium bricks, the technique of applying them and testing them, and the essential technical processes in using magnesium bricks. The paper also proposes, based upon the experience of the plant, that magnesium bricks should be laid to about 8 m in the firing zone; in the cooling zone, phosphate bricks are more abrasion resistant; the transition zone should be laid entirely with phosphate bricks; heat insulating bricks are best for the decomposition zone; the preheat zone should be laid with clay bricks.

AUTHOR: YU Zhenxian [0205 2182 0341]

ORG: Shuicheng Cement Plant

TITLE: "Effect of Titanium-containing Slag on the Strength of Cement"

SOURCE: Beijing SHUIJNI [CEMENT] in Chinese No 2, 10 Feb 81 pp 24-27

ABSTRACT: For a long time, Shuicheng Cement Plant has been using slag of the blast furnace of Shuicheng Iron and Steel Mill as the mixing material. That mill receives iron ores from many suppliers, and some times the iron ore contains titanium. For this reason, the titanium content of the slag fluctuates a great deal. When the mill uses ordinary iron ores, the TiO_2 content of the slag is less than 1 percent; with titanium-containing iron ores, the TiO_2 content is 12-14 percent. This paper reports various studies on the effects of the titanium content of the slag on the strength of the cement. It appears that the major influence is on the rate of increase of the strength of the cement; the influence is especially serious on the rate of increase from 7th to 28the day to cause the compression strength and the tensile strength to be lower than the cement using ordinary slag. Detailed data are presented.

6248
CSO: 4009

AUTHOR: CAO Jianye [2580 0256 2814]

ORG: Taiyuan Research Institute, Academy of Coal Sciences

TITLE: "Some Aspects of the Mechanization of Drivage in Coal and Coal-Rock Headings in China"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 1, 1981 pp 8-10

TEXT OF ENGLISH ABSTRACT: The author points out that the development of a medium-size heading machine is necessary in China. Such a machine with a boring-type cutter head and electrohydraulic-driven crawler is more adaptable. A description is also given of the type of back-up system, dust suppression, sizes of headings, types of supports and support material used. The author concludes that in order to increase productivity and lower operational costs, the heading machine must include cutting, loading, hauling and supporting systems with water spraying dust suppression, a gas alarm system, laser guidance, etc.

AUTHOR: WANG Xianglin [3769 4382 7792]
ZHAO Hongzhu [6392 1347 3796]

ORG: None

TITLE: "Simple Explanation of the Rock Pressure Phenomenon in Coal Face Using Powered Supports and Hydraulic Props"

SOURCE: Beijing MEITAN DEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 1, 1981 pp 10-15

TEXT OF ENGLISH ABSTRACT: The rock pressure phenomenon in a coal face with powered supports and hydraulic props is different because of the difference between working patterns, working loads, advance rate and adaptability to various geological conditions. However, the same values occur in the following: 1) the length between powered supports and caving area; 2) proportion between top subsidence and distance to coal face, seam height, and advance rate. In addition, different values occur in the following: 1) top subsidence; 2) working load distribution; 3) the stability of immediate roof and 4) pressure of support on roof and floor.

AUTHOR: ZHANG Hongxun [1728 1347 0534]

ORG: Shenyang Coal Mine Design and Research Institute

TITLE: "Leakage and Overcurrent Protection of Coal Mine 6 kV Electrical Network"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 1, 1981 pp 27-32

TEXT OF ENGLISH ABSTRACT: According to the investigation of leakage protection in the transformer substation of Shuangyashan and Fushun Coal Mine Administrations, detailed analysis is given to the status and various breakdowns of a 6 kV network. A Chinese safety limit is put forward dealing with foreign conditions, including the safety limit of electrical shock and gas explosion. Ways of improving technical specifications for China-made equipment are described. Finally, detailed discussion is given to overcurrent protection, setting and coordination of 6 kV overcurrent protection, coordination of overcurrent and low-voltage protection and operation source.

AUTHOR: GAO Guilin [7559 2710 2651]
LIAN Wei [1670 3837]

ORG: GAO of the Supply Bureau, Ministry of Coal Industry; LIAN of the Design and Management Bureau, Ministry of Coal Industry

TITLE: "Hoisting Wire Rope in Coal Mines and Their Optimum Selection"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 1, 1981 pp 32-37

TEXT OF ENGLISH ABSTRACT: Optimum selection of hoisting wire rope in coal mines is meaningful for safety operation of mines, economic operation of equipment and lowering coal prices. In this paper a detailed description is given to correct the selection of wire rope for inclined and vertical shafts and shaft sinking hoisting, analyzing the construction of wire rope.

AUTHOR: ZHU Renyi [2612 0088 6095]
JIAO Chuanwu [3542 0278 2976]

ORG: Both of the Beijing Exploitation Institute, Institute of Coal Sciences

TITLE: "Calculating Movement and Deformation of Arbitrary Points with Rectangular Checker Network after Mining Inclined Seam (Part I)"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 1, 1981 pp 40-45

TEXT OF ENGLISH ABSTRACT: In this paper principles and methods of applying a rectangular checker are given for calculating surface movement and deformation of building, railway and pipeline facilities in arbitrary locations of surface subsidence trough. Using this method all data can be calculated for an arbitrary point in a surface subsidence trough, including subsidence, inclination, curvature, horizontal movement and deformation, etc. This method is adaptable not only for the calculation of a regular coal face, but also for that of an irregular coal fact. In addition, it is simpler for horizontal seam conditions.

9717
CSO: 4009

AUTHOR: HE Chengshun [0149 2110 7311]
ZHOU Kaifu [0719 7030 1381]
ZHANG Guanxi [1728 6034 1585]

ORG: All of the South China Sea Institute of Oceanology, Chinese Academy of Sciences

TITLE: "The Determination of Mercury at ppt Level in Seawater by the Enrichment with Sulfhydryl Cotton and Cold Vapor Atomic Absorption Method"

SOURCE: Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 12 No 1, 1981 pp 33-40

TEXT OF ENGLISH ABSTRACT: In this paper a simple and sensitive method for the determination of organic and inorganic mercury at ppt levels in seawater is described.

The present method utilizes sulfhydryl cotton to enrich organic and inorganic mercury in the seawater. The enriched organic mercury was first eluted with 10 percent NaCl + 1N HCl (or 2N HCl) and the inorganic mercury was eluted with 6N HCl saturated with sodium chloride. The eluted organic and inorganic mercury was determined by the cold vapor atomic absorption method. Due to the simplicity of the apparatus and the convenience of operation, it is available for operation on board ship.

[Continuation of HAIYANG YU HUZHAO Vol 12 No 1, 1981 pp 33-40]

The precision of the above method is rather high. The relative standard deviation for 20 ng/l of organic mercury is 6.4 percent and for 15 ng/l of inorganic mercury is 6.6 percent. The recovery percentage of methyl-mercury is about 80-100 percent and of inorganic mercury is about 96-110 percent. In comparison of this enrichment of sulfhydryl cotton and cold vapor atomic absorption method with reduction-aeration preconcentration at ordinary temperatures, the same results are obtained. The sensitivity of determination reaches 1 ng Hg/l when 1 liter of seawater sample is used for analysis.

AUTHOR: ZHANG Tianfu [1728 3240 0154]
GU Tangxiu [0657 1016 4423]
XU Xianyi [1776 6343 5030]

ORG: All of the Institute of Oceanology, Chinese Academy of Sciences

TITLE: "Determination of Nitrates and Nitrites in Seawater by Gas Chromatography"*

SOURCE: Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 12 No 1, 1981 pp 49-52

TEXT OF ENGLISH ABSTRACT: A simple, sensitive method is presented for the determination of nitrates and nitrites in seawater. The principle of the method is that aqueous nitrate ion is converted to nitrobenzene by reaction with benzene in the presence of a catalyst. Nitrobenzene is then quantitated by Electron Capture Gas Chromatography (GC-ECD). The interference of chloride is prevented by using saturated silver sulfate. The detection limit for nitrobenzene is ca. 10^{-12} g.

*Contribution No 592 from the Institute of Oceanology, Chinese Academy of Sciences.

AUTHOR: LIU Mingxing [0491 2494 2502]
GU Hongkan [7357 1347 1030]

ORG: Both of the Institute of Oceanology, Chinese Academy of Sciences

TITLE: "The Concentrations of Some Trace Metal Ions in Interstitial Waters from the East China Sea"*

SOURCE: Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 12 No 1, 1981 pp 53-60

TEXT OF ENGLISH ABSTRACT: The concentrations of Zn, Cu, Pb, Cd, Sn and Bi ions in interstitial waters from the East China Sea have been measured.

The "antiadsorption physical coating mercury film electrode inverse polarography system" was used for the measurement. The "dilution method" was used to obtain the interstitial water.

The concentrations of the above ions in the interstitial waters are about two to six times higher than those in the seawater. The high ion contents are in the muds in which the Eh was negative and the pH was around 7.6. The low ion contents are in the sand. Obviously, it was caused by decomposition of bio-organic matter in mud, and the low pH and negative Eh transfer the Zn, Cu, Pb, Cd, Sn and Bi into the interstitial water.

*Contribution No 593 from the Institute of Oceanology, Chinese Academy of Sciences.

AUTHOR: WU Baoren [0702 5508 0088]

ORG: Shandong College of Oceanology

TITLE: "A Digital Sea Surface Thermometer"

SOURCE: Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 12 No 1, 1981 pp 67-73

TEXT OF ENGLISH ABSTRACT: The measurement of sea surface temperature is a fundamental work for remote sensing. The temperature of water under the surface with a depth of 0.3 - 1 cm can be measured with this instrument--the digital sea surface thermometer. The sensor of the instrument looks like a float. Each temperature value is converted into a frequency signal with a linear relationship. The surface temperature value is shown on the digital display with MOS medium scale integration. Measuring range is 0-30°C, accuracy is 0.1°C, resolution is 0.1°C.

9717
CSO: 4009

AUTHOR: LIU Songwei [0491 7313 1218]

ORG: None

TITLE: "The Review of Seismic Exploration of the Western Part of Huabei Basin"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 1-17

TEXT OF ENGLISH ABSTRACT: The western part of Huabei Basin is one of the oil and gas regions in China. Seismic exploration has played an important role in the discovery of various oil and gas traps. So far, there has been a high degree of exploration in the sedimentary depressions where seismic methods are best applicable. However, in recent years the prospecting effect has shown a manifest tendency to gradually decline year-by-year. Therefore, it is a matter of concern to many how to do seismic surveys in this area in the future.

This paper, based on a summing-up of past experiences, is an attempt to describe the normal seismic exploratory process for a dustpan shape depression, and points out the main technique which should be adopted to improve the quality of seismic data to be gathered, processed and interpreted.

AUTHOR: XU Zhongying [1776 0022 5391]

ORG: None

TITLE: "Direct and Inverse Methods for Seismic Waves in a Layered Medium"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 18-26

TEXT OF ENGLISH ABSTRACT: Direct and inverse methods are applied to the typical model of structure in the eastern part of the Sichuan Basin. The results show that the direct method is helpful in understanding the character of seismic waves from complicated structures, while the inverse may restore the structure to its true position which cannot correctly be restored by using conventional migration (including diffraction and wave equation migration), so that a true form of the structure may be obtained.

AUTHOR: SHAO Youying [6730 1635 5391]

ORG: None

TITLE: "Detecting Stratigraphic Parameters by the Sign-bit--Velocity Analysis of Multilayered Medium"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 27-42

TEXT OF ENGLISH ABSTRACT: The method of employing the DIX formula to get the interval velocity from the spectrum of horizontally stacking velocity is only applicable to a horizontal layered medium. A new method must be sought for the layered medium with an arbitrary dip. This paper presents the velocity analysis method for a multilayered medium, which can be used to scan the two-dimensional dip and velocity in the depth domain in accordance with the layer-by-layer recursion formula derived from CDP time-distance curve equation of the dip formations of a two-dimensional arbitrary plane. Then, the sign-bit can be detected by using a generalized likelihood method in order to get the velocity, dip and depth for each layer.

AUTHOR: WANG Qingyuan [3769 3237 3293]
CHEN Shou [7115 7445 8590]

ORG: None

TITLE: "Electric Spark Coded Source"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 43-54

TEXT OF ENGLISH ABSTRACT: The coded source is a new source which is fired with a given coded time series. It allows the arbitrary increase of effort or decrease of the distance between CDP so as to obtain a seismogram with a higher S/N ratio. The electric spark source has a high rate of repeatability and accurate firing time, hence, it is a desirable coded source. The coded source can be used not only in on-shore survery, but also in off-shore survey.

In this paper, we mainly discuss the method used to make the time series for the coded source, and put forward four kinds of time series which can be easily realized.

AUTHOR: CHAI Yupu [2693 3768 3877]

ORG: None

TITLE: "The Method for Determining the Depth of Basement by Gravity Anomalies"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 55-63

TEXT OF ENGLISH ABSTRACT: Based on the basic theory of gravity field, we derive the density interface function which expresses the basement relief. This paper is a study of the relationship between the density of overlaying sediments and depth variation. We also provide the equivalent residual density formula and conclude the the formula for calculating basement depth from gravity anomalies. The method was used for calculating the gravity anomalies in the Baiyangdian area and the results conform to observed curves.

AUTHOR: LI Musun [2621 3092 1327]
FEI Zhenyu [6316 7201 1342]

ORG: None

TITLE: "Correlation Comb Filter for Aeroelectrometer"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 64-74

TEXT OF ENGLISH ABSTRACT: The comb filter designed for the model M-1 pulse type aeroelectrometer is an appropriate tool for noise suppression. It may be used for reference in other geological equipment. This paper mainly discusses the principles of the comb filter, and shows its calculating formula and details the design circuit as well.

AUTHOR: WANG Chengshu [3769 2110 2562]

ORG: None

TITLE: "The Calculation for Deconvolution of Minimum Entropy"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 75-80

TEXT OF ENGLISH ABSTRACT: In this paper, we further discuss the minimum entropy method, provide the calculating formula and FORTRAN program, and give an example to show where to pay attention during calculation.

AUTHOR: ZHAO Shangwu [6392 1424 2976]

ORG: None

TITLE: "Spatial Correction Method in Surface Relief Area"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 81-86

TEXT OF ENGLISH ABSTRACT: The spatial correction method in the case of the relief datum plane is described in this paper.

AUTHOR: WU Jianguo [6762 1696 0948]
YIN Bajin [3009 0360 2443]

ORG: None

TITLE: "Color Display Technique for Seismic Section"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 87-95

TEXT OF ENGLISH ABSTRACT: The color display of seismic data is of great significance, as is well known. But how is the color display realized on our equipment used? This paper offers a scheme for its implementation: in respect to hardware, we have designed four circuit boards and a device which can change color filters automatically; in respect to software, we have made three programs and due modification of the GS-3410 plotting program used in the 1704 computer. The scheme provides 14 color codes and displays 9 kinds of cross sections, such as bright spot, interval velocity, pseudo velocity log and instantaneous information, etc.

AUTHOR: ZHOU Shizhong [0719 0013 1813]

ORG: None

TITLE: "A Layout Chart of Slalom Lines"

SOURCE: Baoding SHIYOU DIQIUWULI KANTAN [OIL GEOPHYSICAL PROSPECTING] in Chinese No 1, 1981 pp 96-97

TEXT OF ENGLISH ABSTRACT: The layout chart of the slalom line presented in this paper can predict the spread of reflection points and control the quality of the field operation.

9717
CSO: 4009

AUTHOR: LUO Guqin [5012 6253 0615]
WAN Deda [8001 1795 6671]

ORG: Both of Jiangxi Printing Company

TITLE: "Some Reforms of the Plastic Plate Making Process"

SOURCE: Beijing YINSHUA JISHU [PRINTING TECHNOLOGY] in Chinese No 2, 80 pp 19-22

ABSTRACT: The thin relief block one-side rotary printing press has not been used in Jiangxi Printing Company for very long, the equipment for making the plastic plates is not complete. Originally, the plate had to be nailed onto a wooden board to be worked on a flat engraving machine. Later, a vacuum pump was used instead to overcome the defect of having to nail the plate on a board, but the plate still had to be curved before it could go on the printing press, and there was no curving tool. The authors had to heat the plate in 60°C warm water before curving the plate on a curving mold made by themselves and cooling it on the mold. Although this process had lots of problems, the quality of the plastic plate was guaranteed. After repeated studies, it was decided to install a vacuum curved plate absorbing device on a roller to curve the plate and engrave it at the same time. The preheating process was thus omitted. These improvements are described.

AUTHOR: KANG Zhenguo [1660 2182 0948]

ORG: Zibo Printing Press, Shandong Province

TITLE: "A Quarto Automatic Paper Feeding Machine Made by [the Workers] of the Printing Press Themselves"

SOURCE: Beijing YINSHUA JISHU [PRINTING TECHNOLOGY] in Chinese No 2, 80 p 27

ABSTRACT: The authors and colleagues at the press tried to raise the level of automation of the printing process. After more than a year's efforts and with the assistance of other organizations, they made a quarto automatic paper feeding machine, which had been tested for several months to make certain its proper operation. It has now been officially used and the condition of manual feeding of paper at the plant has been changed. The technical specifications of the machine and a photo depicting its appearance are included.

AUTHOR: DONG Lianguan [5576 1670 6034]

ORG: Hangzhou Municipal Research Institute of Chemical Engineering

TITLE: "Development of Printing Ink in China Since the Liberation"

SOURCE: Beijing YINSHUA JISHU [PRINTING TECHNOLOGY] in Chinese No 2, 80 p 45

ABSTRACT: Before the liberation, there was no printing ink industry in China, except for some scattered small shops. Today, the country has 30 large and small printing ink plants with an annual production of close to 20,000 tons of various types of printing ink, about 40 percent for resin printing and 30 percent for lead printing. The larger of these are located in Tianjin, Shanghai, Hangzhou, Gangu, etc. The history of development of the printing ink industry in China may be divided into 3 stages of 10 years each. In the first decade after the liberation, the emphasis, just like other industries, was on adjusting the ownership system, and the products consisted of primarily oil type ink, using vegetable oil and pigment as the raw materials. The use of resin for ink -making began around 1960. The second stage of development was launched by the Ministry of light Industry which organized the technological resouces of all the plants and brought them to Tianjin Printing Ink Plant to carry out the research on making resin ink. In the early 70's, the Beijing RENMIN RIBAO inported from Japan several rotary printing presses with a speed of 25,000 rotations/hour to print 4 colors in one operation. In the summer of 1973, the Ministry of Light Industry once again ordered research to proceed on making ink for the rotary presses to start the third stage of China's development of printing ink.

AUTHOR: LI Shanwu [2621 6365 2976]

ORG: None

TITLE: "Some Viewpoints Regarding Problems of Standardization in the Printing Industry"

SOURCE: Beijing YINSHUA JISHU [PRINTING TECHNOLOGY] in Chinese No 2, 80 pp 58-59, 44

ABSTRACT: In the document CONCERNING FOMULATION OF STANDARDIZED MANAGEMENT PROCEDURES IN PEOPLE'S REPUBLIC OF CHINA, the State Council mentioned that "standardization is an important measure for organizing modernized mass production..." This paper explains that technical standard is the basis upon which the quality of products is to be measured. For this reason, every work process of the printing industry should have a standard. Without standardization of all the work processes there can be no modernization. According to statistics, by 1977, the state had issued 1810 standards and on the ministry level, more than 10,000 standards had been issued. In the printing industry, however, there was only one, Document GB788-65 defining the sizes of books, magazines, etc. In the printing industry, there is also a lack of understanding regarding standardization, although some local areas have formulated some quality standards for printed matters. This paper discusses the aspects of the printing industry for which standards are urgently needed at present and for which the state and the ministries are expected to issue or approve the standards.

6168
CSO: 4009

AUTHOR: ZHANG Zhengmin [1728 2973 2404]

ORG: Commission for Integrated Survey of Natural Resources, Chinese Academy of Sciences

TITLE: "The Assessment of the Economic Feasibility of Solar Water Heaters"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 115-123

TEXT OF ENGLISH ABSTRACT: In this paper, formulas for the economic assessment of the solar water heater are derived and the related C-P figures are suggested on the basis of the concept of "net revenue." Using these formulas and figures, the assessment of the economic effect and the rational use of the solar water heater in China was preliminarily studied. It is shown that the economic effect is low, only suitable in certain conditions, and the key to improvement is to construct and develop cheaper heaters with high conversion efficiency. When the unit price of the solar water heater comes down to 80 yuan per square meter (Chinese currency) and its efficiency is raised to 60 percent, it will be economically feasible in north China and part of south China.

AUTHORS: YE Yaqu [5509 7161 6253]
LU Zhongqian [7120 1813 0051]
WU Zongyan [0702 1350 8746]

ORG: All of the Shanghai Institute of Ceramics, Chinese Academy of Sciences

TITLE: "The Thermoelectrical Properties of Amorphous Silicon Thin Films by Glow Discharge Deposition"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 124-131

TEXT OF ENGLISH ABSTRACT: This article reports the results of a study of the properties of amorphous silicon film (GD-aSiH$_x$) prepared by the glow discharge technique, measuring its electrical conductivity and photoconductivity. The experimental results indicate that the GD-aSiH$_x$ material prepared has an obvious photoconductive effect. Under illumination, its electrical conductivity increases by two orders of magnitude. From the absorption and spectral response curve of the GD-aSiH$_x$, the mobility gap E_g of 1.65 eV is obtained. Strong photoresponse is found near E_g 1.65 eV, weak response is found at localized states between 1.65 eV and 0.75 eV, and below 0.75 eV there is no response. This evidence shows that the material prepared is a weak n-type semiconductor. The relation of the photoconductivity versus light intensity shows that a [illegible] recombination process plays a dominant role when the photogenerated carriers move toward the E_c. High and low temperature electrical conductivity and photoconductivity are also

[Continuation of TAIYANG NENG XUEBAO No 2, 1980 pp 124-131]

measured. Under low temperature conditions, the electrical conductivity of GD-aSiH_x decreases as the temperature decreases, and is a function of the reciprocal of the temperature. The curve may be divided into three regions: activated (with the activated energy about 0.66 - 0.73 eV), weakly activated and non-activated processes. Under high temperature conditions, the electrical conductivity increases while the temperature increases. The relationship between the temperature and the conductivity is nonlinear. This fact indicates that electronic transfer within GD-aSiH_x is brought about by the hopping transport mechanism. Photoconductivity can be demonstrated by the R_D/R_L value (R_D: the dark resistivity, R_L: the light resistivity). At low temperatures, when T = 293-193 K, $(R_D/R_L)_{L.T.}$: $(R_D/R_L)_{R.T.} \approx 10$, when $T < 193$ K, R_D/R_L decreases progressively until R_D is equal to R_L. At high temperatures, the R_D/R_L value decreases as the temperature increases. When the temperature is higher than 373 K, $R_D \approx R_L$.

AUTHOR: CHE Maolong [6508 5399 7127]
TANG Yunian [0781 6276 1628]

ORG: Both of the Solar Energy Research Center, Shanghai Mechanical Engineering Institute

TITLE: "A Study of Faceted Fixed Mirror Solar Concentrator Design"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 132-139

TEXT OF ENGLISH ABSTRACT: A n-θ chart was obtained based on analyzing the optic principle of FMSC theoretically and discussing the design method in this paper. The n-θ chart can be used to determine the number and location of every mirror surface. It simplifies calculation for a FMSC design and may be helpful in further studying FMSC.

AUTHOR: BI Zhichu [3968 0662 0443]
LI Yushu [2621 3768 2579]
LIU Zhenghui [2692 2973 6540]

ORG: All of the Institute of Photographic Chemistry, Chinese Academy of Sciences

TITLE: "A Study of the Transparent Electrode Photo-Galvano-Voltaic Cell"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 140-147

TEXT OF ENGLISH ABSTRACT: A simple photo-galvano-voltaic cell has been constructed by using a Nesa glass coated with SnO_2 on both sides as transparent electrodes, one of which is further coated with a photosensitizing dyestuff, meso-tetraphenylporphrin (TPP), forming the photo-cathode, and using an aqueous solution of thionine and Fe^{+++}/Fe^{++} redox couple as the electrolytic solution. By adding a surfactant, Na Lauryl sulfate, into the solution, the surface resistance of the TPP film is greatly lowered so that the photocurrent of the cell is markedly enhanced, and the light conversion efficiency is increased more than twofold. It has been demonstrated that a multilayer liquid film photo-galvano-voltaic cell with film thickness of less than 100μ can greatly increase the light conversion efficiency, and the open-circuit voltage of more than two volts can be easily achieved. Several properties, especially the semiconducting characters of the TPP coating material, have been shown by analyzing the action spectrum, the I-V characteristic

[Continuation of TAIYANG NENG XUEBAO No 2, 1980 pp 140-147]

curve, and the photoresponse light intensity dependency of this photo-galvano-voltaic cell.

AUTHOR: NI Shouyuan [0242 0649 0337]
CHANG Zhenyan [1603 2182 3508]
CHEN Zhongya [7115 1813 0068]

ORG: All of the Institute of Electrical Engineering, Chinese Academy of Sciences

TITLE: "The Principle and Experimental Research of Variable-Speed Constant-Frequency Constant-Voltage Generator Using Field Modulation"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 148-155

TEXT OF ENGLISH ABSTRACT: The field modulated generator system is a new variable-speed constant-frequency generating equipment. It is a specially designed three-phase high frequency alternator. Using the principle of field modulation and demodulated technique of electronics, a constant frequency output independent of the speed of the prime-mover is obtained. This paper describes the principle of operation of this generator system, analyzes component parts of the system, presents experimental results of a 4 KW prototype and discusses its applications.

AUTHOR: LI Zhilan [2621 5347 5695]
WANG Yifang [3769 5030 2455]

ORG: Both of the Department of Engineering Thermophysics, University of Science and Technology of China

TITLE: "An Analysis of Steady State Heat Transfer for a Conical Focusing Solar Energy Collector"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 156-165

TEXT OF ENGLISH ABSTRACT: A detailed analysis of steady state heat transfer is made in this paper for a conical focusing solar energy collector with a cylindrical glass cover around the absorber. The equilibrium temperature under various conditions has been calculated using a computer. The influence of the diameter of the absorber, wind speed and the emissivity of the absorber surface on the equilibrium temperature have been discussed. The calculation shows that using the selective coating and the cylindrical glass cover both are effective means to improve the thermal performance of the collector. The cylindrical glass cover can also make the collector work more steadily. A design of a solar autoclave based on this analysis will be available for the rural areas in China which have plenty of sunlight but are lacking in fuel.

AUTHOR: JIANG Yi [3068 0310]
LI Yuanzhe [2621 0337 0772]
DI Hongfa [3695 3163 4099]

ORG: All of Qinghua University

TITLE: "Research on the Method for Calculation of the Transmittance of Partially Transparent Mediums"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 166-175

TEXT OF ENGLISH ABSTRACT: In this paper, based on the relationship of energy balance at the interface of a transparent body, the energy diminution of the solar radiation passing through a transparent body has been calculated and a method for calculating the transmittance of the transparent bodies is given. It can be used in calculating the transmittance of a transparent body system which is composed of various different mediums. For the purpose of analysis, it can also be used to predict the influences of the various factors.

This paper also analyzes Hottel's approximate equation and points out the possible source of the error involved. Compared with the familiar infinite serial method of summarization, this method is clearer in physical concept and simple in calculation.

AUTHOR: LI Yibing [2621 0076 0365]
DONG Dianhong [5516 3013 3163]
ZHANG Shufen [1728 3219 5358]

ORG: All of Changchun Institute of Applied Chemistry, Chinese Academy of Sciences

TITLE: "The Light-Spot-Scanning Apparatus and Research on the Uniformity of Thin Film CdS-Cu2S Solar Cells"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 176-180

TEXT OF ENGLISH ABSTRACT: In order to fulfill the requirements of large area thin film solar cell research, we have designed and set up a light-spot-scanning apparatus. Various thin film solar cells or materials can be scanned with an [illegible] light spot while specimen signals in terms of photocurrent or photovoltage are simultaneously recorded with a recorder so that the difference in uniformity of solar cells or [illegible] can be examined directly. With this apparatus we studied the photocurrent [illegible] and the relation between the uniformity and conversion efficiency of thin film CdS-Cu2S solar cells.

AUTHOR: YU Shanqing [0205 0810 1987]

ORG: Shanghai Institute of Ceramics, Chinese Academy of Sciences

TITLE: "The Optical Properties of Materials for Spectral-Selective Coatings"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 181-188

TEXT OF ENGLISH ABSTRACT: There are three main possibilities for the application of solar energy: photo-thermal conversion, photovoltaic conversion and photochemical conversion. Therefore, photo-collection plays an important role in solar energy application technology. Research on the interrelation between solar radiation and substances, exploration of methods for increasing photo-collective efficiency as well as development of new optical-collective materials are important for solar energy application.

At present, the design and study of spectral selective coatings by use of optical interference filters are very interesting. These optical-collective coatings consist basically of a stack of one or more layers of alternately high and low refractive indices. Appropriate choice of refractive index, layer thicknesses and number of layers permits the development of advanced spectral-selective coatings.

In order to design the useful optical-collective coatings, it is necessary to use

[Continuation of TAIYANG NENG XUEBAO No 2, 1980 pp 181-188]

a lot of materials which have different indices of refraction. We have done the following: (1) Among the important optical parameters of more than 180 AB type compounds, the indices of refraction of different materials are reviewed; (2) The principles in the change of refractive index of materials are discussed with respect to chemical bond parameters; (3) The magnitude of refractive indices of some interesting materials is predicted.

AUTHOR: CUI Rongqiang [1508 1369 1730]
QIN Huilan [4440 5610 5695]

ORG: Both of Xian Jiaotong University

TITLE: "An Investigation of the Texture Surface Silicon Solar Cell"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 189-196

TEXT OF ENGLISH ABSTRACT: This paper analyzes and discusses the optical and electrical properties of the texture surface silicon solar cell. A new method of etching by LiOH is presented, and a preliminary discussion of the etching mechanism is carried out.

AUTHOR: JIN Dongzhi [6855 2639 2784]

ORG: Beijing Solar Energy Research Institute

TITLE: "The Design of a Flat Plate Fresnel Lens and Its Optimal Design Method"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 197-204

TEXT OF ENGLISH ABSTRACT: This paper deals with the principle of focusing, design formula, focal size calculation and its optimal design method for the flat plate Fresnel lens optically. The focal size has been calculated under both ideal parallel light and natural sunlight conditions respectively. The results from natural sunlight approximately equal the measured ones.

AUTHOR: FANG Chengchao [2455 2110 6389]
GE Demin [5514 1795 3046]

ORG: FANG of the Energy Sources Laboratory, Tianjin University; GE of the Paint Factory of Tianjin

TITLE: "The Heat Performance of the Selected Black Coating for Flat-Plate Collector"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 205-213

TEXT OF ENGLISH ABSTRACT: The heat performance of three black paints is studied in this paper. It is shown by the results of the test under low temperature conditions that the efficiency of the flat-plate solar collector is mainly dependent on the absorbancy of the collector coating. Therefore, we suggest that it is not necessary to use selective coating for the collector in heating water up to 70°C. Using nonluminous black paint is better than selective coating.

AUTHOR: CHENG Shuxia [4453 2562 7209]
GE Xinshi [5514 2450 4258]

ORG: Both of the Department of Engineering Thermophysics, University of Science and Technology of China

TITLE: "Research in the Measurement of Solar Radiation by Transient Technique"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 2, 1980 pp 214-220

TEXT OF ENGLISH ABSTRACT: A new technique for measuring the intensity of solar radiation is presented. It consists of measuring the heating and cooling rate of the receiver of the instruments with and without radiation incidence respectively. The experimental apparatus is described and the theoretical analyses of the technique and the measured results are given.

AUTHOR: GE Xinshi [5514 2450 4258]

ORG: University of Science and Technology of China

TITLE: "Analysis of the Radiation Characteristics of the Direct Gain Passive Solar Building"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 1-6

TEXT OF ENGLISH ABSTRACT: This paper discusses the radiation characteristics of the direct gain passive solar building with diffuse transparent glazing. By using the "net flow method," the formulas for calculating the radiation characteristics are derived. The effects of the radiation properties of the internal walls, floor and ceiling and the geometric parameter A_0/A_w on the radiation characteristics are calculated and illustrated by charts.

AUTHOR: ZHU Yanning [2612 1693 1380]
XIAO Xurui [5135 4872 3843]

ORG: Both of the Institute of Photosensitive Chemistry, Chinese Academy of Sciences

TITLE: "A Study of Titanium Dioxide Electrodes for the Photoassisted Electrolysis of Water"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp [illegible]

TEXT OF ENGLISH ABSTRACT: A successful reproducible method of preparation of semiconductor photoelectrodes which was used as photoanode in the PEC cell for solar energy conversion has been described.

Titanium dioxide film was thermally formed in the titanium plate in an electric furnace and was reduced in [illegible] argon or hydrogen atmosphere for obtaining an n-type semiconductor photoelectrode. The photoelectrochemical properties and the spectrum response of the PEC cell consisting of titanium dioxide were investigated, and the evolution of hydrogen was observed obviously under sunlight.

AUTHOR: WANG Bingzhong [3769 3521 1813]
PAN Gendi [3382 2704 1229]

ORG: WANG of the Academy of Meteorological Research, Central Meteorological Service; PAN of the Beijing Meteorological Center, Central Meteorological Service

TITLE: "The Transparency of the Atmosphere over China and Its Computation"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 13-22

TEXT OF ENGLISH ABSTRACT: The seasonal distribution of the transparency of the atmosphere over China has been analyzed, especially with a view to facilitate solar energy engineering. All noon-time solar radiation observations are converted to values for air-mass M = 2 for contrast. The method of computing is described.

AUTHOR: LU Weide [7120 4850 1795]
GUO Huifen [6675 1979 5358]
SUN Xiaolan [1327 1321 5695]

ORG: LU and GUO both of the Beijing Solar Energy Research Institute; SUN of the University of Science and Technology of China

TITLE: "The Design Study of Solar Water Heaters with Natural Circulation"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 23-32

TEXT OF ENGLISH ABSTRACT: Based on experimental study, the mathematical model of a solar water heating system with natural circulation was discussed and selected. Using the mathematical model chosen, a computer analysis of some design factors has been conducted. The conclusions obtained indicate that the collector efficiency is the main factor influencing the system thermal performance and, relatively speaking, the geometric factors, such as the height difference between the collector and water tank, the height/diameter ratio of the tank and the size of the flow pipes, etc., do not largely influence the system performance under their reasonable arrangement. This analysis will provide some useful references for solar thermosyphon water heating system design.

AUTHOR: LI Yuanzhe [2621 0337 0772]

ORG: Qinghua University

TITLE: "The Reasonable Steps of Flat Plate Collector for Increasing Its Heat Collecting Efficiency"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 33-38

TEXT OF ENGLISH ABSTRACT: In view of the technical economy, this paper makes an analysis of the heat loss component between the plate and covers of the medium and low temperature type collectors. Analysis indicates that, as a first choice, using the selecting coating to reduce radiation loss is reasonable. When the selecting absorbing ratio of the plate is greater than a certain value, we must direct our attention to reducing the convection loss. When the collector has a plate temperature less than 85°, the reasonable range of absorbing ratio is not greater than 10.

AUTHOR: ZHANG Bangji [4545 6721 1015]
HU Bingsheng [5170 3521 3932]

ORG: ZHANG of Anhui Luan Teachers College; HU of Anhui Teachers University

TITLE: "The Preliminary Discussion of the Property of a Spherical Reflector"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 39-46

TEXT OF ENGLISH ABSTRACT: This paper discusses the principle of the concentrating property of the spherical reflector, derives the light energy distributing function, and gives the design of the heat energy receiver.

AUTHOR: KOU Peilin [1379 1014 2651]

ORG: Shaanxi Teachers University

TITLE: "Fundamental Formulas for Designing Fresnel-type Lenses of Different Utilizations"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 47-50

TEXT OF ENGLISH ABSTRACT: This paper derives and discusses the fundamental formulas for diverging and parallel light of Fresnel-type lenses. We have made two such lenses.

AUTHOR: GE Xinshi [5514 2450 4258]
SUN Xiaolan [1327 1321 5695]

ORG: Both of the Department of Engineering Thermophysics, University of Science and Technology of China

TITLE: "Radiation Heat Transfer in a Coverglass-Absorber System"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 51-58

TEXT OF ENGLISH ABSTRACT: This paper is concerned with the problem of the radiation heat transfer in a coverglass-absorber system, which is of great importance in the use of solar energy and in the thermal design of building engineering. The first part of the paper presents a method for calculating the absorbed solar energy by the absorber and the transparent covers in the system. The results of the calculation for two illustrative examples are given. The second part of the paper gives an analysis of the radiation heat loss by the absorber in the system consisting of an absorber with such a cover that has a significant transmittance in the infrared thermal radiation region. The formula obtained for the calculation of radiation heat loss is easy to use. The physical meaning of the formula is also obvious.

AUTHOR: CEN Huanxia [1478 1634 7209]

ORG: Qinghua University

TITLE: "Calculation of the Fraction 'f' of the Heating Load Supplied by Solar Energy"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 59-68

TEXT OF ENGLISH ABSTRACT: In this paper, the factors affecting the f value are analyzed first, then the three methods (f chart, ϕ chart and $\bar{\phi}$-f chart method) for the determination of the f value are described, and the special features of each are pointed out. Finally, based on the calculated results of practical examples, a comparison of these three methods is made. The author prefers the $\bar{\phi}$-f chart method, and recommends a correctin factor for the calculated value.

AUTHOR: HAN Guilin [7281 2710 2651]

ORG: Changchun Institute of Applied Chemistry, Chinese Academy of Sciences

TITLE: "The Developing Picture of Large-Scale Low-Cost Cu_2S/CdS Thin Film Solar Cell Prepared by the Solution Spraying Method"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 69-74

TEXT OF ENGLISH ABSTRACT: A brief description of development of Cu_2S/CdS thin film solar cells prepared by the solution spraying method is presented. A review is given on the potential use of Cu_2S/CdS-sprayed thin film solar cells for large-scale terrestrial applications. $Cu_2S/Cd_{1-x} Zn_xS$ thin film solar cells have also been prepared by the solution spraying method, and it is expected that the conversion efficiency could reach about 15 percent. In addition, cells fabricated by the solution spraying method have the advantages of low cost and facility in fabricating. Therefore, it can be expected that $Cu_2S/Cd_{1-x} Zn_xS$ thin film solar cells can meet low costs in industrial production.

AUTHOR: CAO Zechun [2580 3419 3196]
HUANG Jiamei [7806 1367 5019]

ORG: Both of the Shanghai University of Science and Technology

TITLE: "A Method for the Measurements of Series Resistance of the Solar Cell--The Three-Four Probes Method"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 75-80

TEXT OF ENGLISH ABSTRACT: This paper presents an experimental method for the determination of the main parts of series resistance of the solar cell (contact resistance of grid lines and thin layer resistance of diffused layer). This paper contains the principles of the method, the experimental results of the silicon solar cell and comparison with other methods for the same purpose.

AUTHOR: BAO Zongming [0545 1350 2494]
YANG Hengqing [2799 1854 7230]
HUANG Shurong [7806 3219 5554]

ORG: All of the Modern Physics Institute, Fudan University

TITLE: "Fast Reading Minority Carrier Diffusion Length by SPV Method"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 81-86

TEXT OF ENGLISH ABSTRACT: A simple SPV method of fast reading minority carrier diffusion length by taking measurements at two wave lengths was suggested and the results agree reasonably well with those given by the routine method. A small spot probe was developed for minimizing the bypass capacity and can be used for point-to-point measurements on any cross section of an ingot. According to the experiments, growing a SiO_2 thin film by the anodic oxidation method has the advantage of enhancing the signal, while the enhancement is rather stable. The diffusion lengths of single crystals with different resistivities were measured. The sectional profiles of diffusion lengths and their variation with heat treatment were tested for two samples. The diffusion lengths in the base of solar cells were tested as well.

AUTHOR: FANG Duorong [2455 6995 2837]
FENG Xueshan [7458 1331 0810]

ORG: Both of the Institute of Mechanics, Chinese Academy of Sciences

TITLE: "The Performance Experiments of the Solar Flat-Plate Collector of a Flat-Pipe Absorber"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 87-94

TEXT OF ENGLISH ABSTRACT: This paper analyzes the optimal absorber plate structure from the heat transfer point of view. The performance tests of such an absorber have been accomplished, and they show that the flat-pipe absorber plate collector has higher flat-plate collector efficiency, and prove the results attained in heat transfer analysis. The overall loss coefficients and heat capacities of single or double glass cover flat-plate collectors with flat-pipe absorber plates have been measured. The collector efficiency has been calculated by means of measured values U_L, F', α, τ.

AUTHOR: XI Tonggeng [1153 0681 1649]
SHAO Jiesun [6730 0094 5549]
NI Helin [0242 7729 2651]

ORG: All of the Shanghai Institute of Ceramics, Chinese Academy of Sciences

TITLE: "Portable Inspection Equipment for Rapid Measurement of the Emittance"

SOURCE: Beijing TAIYANG NENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese No 1, 1981 pp 95-100

TEXT OF ENGLISH ABSTRACT: In this paper the physical model for emittance ε rapid measurement by A.C. emissometer technique and the experimental fundamentals are discussed. Several boundary conditions in the measurement are analyzed, such as specimen and reference specimen should possess identical temperatures and analogous surface conditions. The emittance of the bright anodized aluminum coating as well as other metallic coatings have been determined with this equipment. The data thus obtained are compared with the measured values by calorimeter methods, and found to be in good agreement. The difference in the ε values does not exceed ± 0.02. The resolving power of the measured ε is found to be ± 0.01.

9717
CSO: 4009

END

END OF FICHE

DATE FILMED

4/15/81